



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

2021

# **Carlsbad Field Office**

## **Environmental Assessment**

**Environmental Assessment DOI-BLM-NM-P020-2021-0267-EA**

**COG Operating LLC  
Lease Number NMNM115417  
Big Papi Federal Com 701H  
Big Papi Federal Com 702H  
Big Papi Federal Com 703H  
Big Papi Federal Com 704H  
Big Papi Federal Com 705H  
Big Papi Federal Com 706H  
APD/CTB/Flowline/Access Roads/Overhead Electric**

Department of the Interior  
Bureau of Land Management  
Pecos District  
Carlsbad Field Office  
620 E Greene Street  
Carlsbad, NM 88220  
Phone: (575) 234-5972

### **Confidentiality Policy**

Any comments, including names and street addresses of respondents, you submit may be made available for public review. Individual respondents may request confidentiality. If you wish to withhold your name or street address from public review or from disclosure under the Freedom of Information Act, you must state this prominently at the beginning of your written comment. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be made available for public inspection in their entirety.

# TABLE OF CONTENTS

<b>1. Purpose and Need for Action.....</b>	<b>3</b>
1.1. Background .....	3
1.2. Purpose and Need for Action .....	4
1.3. Decision to be Made .....	4
1.4. Conformance with Applicable Land Use Plan(s).....	4
1.5. Relationship to Statutes, Regulations or Other Plans .....	4
1.6. Scoping, Public Involvement, and Issues .....	6
<b>2. Proposed Action and Alternative(s).....</b>	<b>7</b>
2.1. Proposed Action .....	7
2.2. No Action .....	16
2.3. Alternatives Considered but Eliminated from Detailed Study .....	16
<b>3. Affected Environment and Environmental Consequences .....</b>	<b>16</b>
3.1. No Action Alternative for All Resource Issues .....	17
3.2. Air Resources.....	17
3.3. Water Resources.....	25
3.4. Watershed .....	42
3.5. Karst Resources.....	43
3.6. Soils.....	47
3.7. Wildlife.....	48
3.8. Special Status Plant Species (SSPS) .....	50
3.9. Vegetation .....	51
3.10. Noxious Weeds and Invasive Plants.....	52
3.11. Range .....	53
3.12. Visual Resource Management.....	54
3.13. Special Designations.....	55
3.14. Cultural and Historical Resources.....	56
3.15. Paleontology.....	57
3.16. Cumulative Impacts.....	58
<b>4. Supporting Information .....</b>	<b>58</b>
4.1. List of Preparers .....	58
4.2. References .....	58

# 1. PURPOSE AND NEED FOR ACTION

---

## 1.1. Background

COG Operating LLC has applied for an application for permit to drill (APD) on Federal BLM managed surface approximately 15.5 miles southeast of Loving, NM. In the application, COG Operating LLC is applying to construct, operate and maintain 2 well pads, 1 Central Tank Battery, access roads, buried flowlines, and overhead electric for the proposed well locations. The proposed action also includes a waiver of the Pecos River/Canyon Complex No Surface Occupancy (NSO) lease stipulation for COG lease parcel NMNM115417 in its entirety (400 ac), further discussed in Chapters 2 and 3. At the time this parcel was nominated and leased, the NSO stipulation, SENM-S-11, BLM proposes to waive was attached erroneously, because the location of the lease parcel does not fall within the Pecos River/Canyon Complex ACEC.<sup>1</sup>

Legal Description:

### **Well Pad 1**

Big Papi Federal Com 701H

Surface Hole Location: 820' FNL & 2,270'FEL, Section 4, T. 26 S., R. 29 E.

Bottom Hole Location: 200' FSL & 430'FEL, Section 9, T. 26 S, R 29 E.

Big Papi Federal Com 702H

Surface Hole Location: 820' FNL & 2,300'FEL, Section 4, T. 26 S., R. 29 E.

Bottom Hole Location: 200' FSL & 1,310'FEL, Section 9, T. 26 S, R 29 E.

Big Papi Federal Com 703H

Surface Hole Location: 820' FNL & 2,330'FEL, Section 4, T. 26 S., R. 29 E.

Bottom Hole Location: 200' FSL & 2,198'FEL, Section 9, T. 26 S, R 29 E.

### **Well Pad 2**

Big Papi Federal Com 704H

Surface Hole Location: 285' FNL & 1,554'FWL, Section 4, T. 26 S., R. 29 E.

Bottom Hole Location: 200' FSL& 2,199'FWL, Section 9, T. 26 S, R 29 E.

Big Papi Federal Com 705H

Surface Hole Location: 285' FNL & 1,524'FWL, Section 4, T. 26 S., R. 29 E.

Bottom Hole Location: 200' FSL& 1,310'FWL, Section 9, T. 26 S, R 29 E.

Big Papi Federal Com 706H

Surface Hole Location: 285' FNL & 1494'FWL, Section 4, T. 26 S., R. 29 E.

Bottom Hole Location: 200' FSL& 431'FWL, Section 9, T. 26 S, R 29 E.

---

<sup>1</sup> “A stipulation included in an oil and gas lease shall be subject to modification or waiver only if the authorized officer determines that the factors leading to its inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified or if proposed operations would not cause unacceptable impacts. If the authorized officer has determined, prior to lease issuance, that a stipulation involves an issue of major concern to the public, modification or waiver of the stipulation shall be subject to public review for at least a 30-day period. In such cases, the stipulation shall indicate that public review is required before modification or waiver. If subsequent to lease issuance the authorized officer determines that a modification or waiver of a lease term or stipulation is substantial, the modification or waiver shall be subject to public review for at least a 30-day period.” (43 CFR 3101.1-4).

## 1.2. Purpose and Need for Action

The purpose for the action is to provide the applicant with reasonable access to extract fluid minerals from a federal oil and gas lease.

The need for the action is established by BLM's responsibility under the Mineral Leasing Act of 1920 as amended, and the Federal Onshore Oil and Gas Leasing Reform Act of 1987.

## 1.3. Decision to be Made

The BLM New Mexico State Office will decide whether to waive the Pecos River/Canyon Complex ACEC NSO lease stipulation<sup>2</sup>, and the BLM New Mexico Carlsbad Field Office will decide whether to approve the APD and, if so, under what terms and conditions.

## 1.4. Conformance with Applicable Land Use Plan(s)

The proposed action is in conformance with the 1988 Carlsbad Resource Management Plan, as amended by the 1997 Carlsbad Approved Resource Management Plan Amendment and the 2008 Special Status Species Approved Resource Management Plan Amendment.

Name of Plan: 1988 Carlsbad Resource Management Plan

Date Approved: September 1988

Decision: [Page 10] "In general, public lands are available for utility and transportation facility development..." [Page 13] "BLM will encourage and facilitate the development by private industry of public land mineral resources so that national and local needs are met, and environmentally sound exploration, extraction, and reclamation practices are used."

Name of Plan: 1997 Carlsbad Approved Resource Management Plan Amendment

Date Approved: October 1997

Decision: [Page 4] "Provide for leasing, exploration and development of oil and gas resources within the Carlsbad Resources Area." The proposed action aids in the development of oil and gas resources and complies with the Surface Use and Occupancy Requirements.

## 1.5. Relationship to Statutes, Regulations or Other Plans

The following is a non-exclusive list of federal statutes that may apply to a proposed action:

- **Archaeological and Historic Preservation Act of 1974 (16 USC 469)** - Provides for the preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of (1) flooding, the building of access roads, the erection of workmen's communities, the relocation of railroads and highways, and other alterations of the terrain caused by the construction of a dam by any agency of the United States, or by any private person or corporation holding a license issued by any such agency or (2) any alteration of the terrain caused as a result of any Federal construction project or federally licensed activity or program.
- **Archaeological Resources Protection Act of 1979, as amended (16 USC 470 et seq.)** - Secures, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals.
- **Clean Air Act of 1970, as amended (42 USC 7401 et seq.)** - Defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer.
- **Clean Water Act of 1977, as amended (30 USC 1251)** - Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

---

<sup>2</sup> The BLM NM will comply with the BLM NM 1203-Delegation of Authority Manual (2017), Appendix 10, Subject Code 3100, to issue a decision on the proposed lease stipulation waiver. This Manual can be available upon request to the BLM.

- **Endangered Species Act of 1973 (16 USC 1531 et seq.)** - Protects critically imperiled species from extinction as a consequence of economic growth and development untempered by adequate concern and conservation.
- **Federal Cave Resources Protection Act of 1988 (16 USC 4301 et seq.)** - Protects significant caves on federal lands by identifying their location, regulating their use, requiring permits for removal of their resources, and prohibiting destructive acts.
- **Federal Land Policy and Management Act of 1976, as amended (43 USC. ch. 35 § 1701 et seq)** – FLPMA established guidelines to provide for the management, protection, development, and enhancement of public lands. 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 impacts connected to the authorization to lease and develop federal mineral estate and to declare how federal mineral estate is managed in the RMP (43 CFR 3101.1 and 43 CFR 1601.0-7(b); BLM Handbook H-1601.09 and H-1624-1 [BLM 2005, 2018a]).
- **Migratory Bird Treaty Act of 1918 (16 USC 703-712)** - Implements the convention for the protection of migratory birds.
- **Mineral Leasing Act of 1920, as amended** – 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 (NEPA) of 1969, as amended (PL 91-90, 42 USC 4321 et seq.), and other applicable laws, regulations, and policies.
- **Mining and Mineral Policy Act of 1970, as amended (30 USC 21)** - Fosters and encourages private enterprise in the development of economically sound and stable industries, and in the orderly and economic development of domestic resources to help assure satisfaction of industrial, security, and environmental needs.
- **National American Graves Protection and Repatriation Act of 1990 (25 USC 301)** - Provides a process for museums and Federal agencies to return certain Native American cultural items such as human remains, funerary objects, sacred objects, or objects of cultural patrimony to lineal descendants, and culturally affiliated Indian tribes and Native Hawaiian organizations and includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional and inadvertent discovery of Native American cultural items on Federal and tribal lands, and penalties for noncompliance and illegal trafficking
- **National Historic Preservation Act of 1966, as amended (16 USC 470)** – An over-arching act that created the framework to allow federal agencies to manage and protect historic and archaeological sites in the United States. NHPA created the National Register of Historic Places (NRHP), National Historic Landmarks (NHL), Advisory Council on Historic Preservation (ACHP), State Historic Preservation Offices (SHPOs), and Section 106 reviews. Section 106 review is always enacted when reviewing all federally funded/permitted projects that have the opportunity to impact sites listed on, or eligible for listing on the NRHP. Section 106 requires federal agencies to take into account the effect a project may have on historic properties and minimize potential harm or damage to historic properties. 36 CFR Part 800 further explains the 106 process; to seek ways to avoid, minimize, or mitigate any adverse effects on historic properties from proposed projects. The Carlsbad Bureau of Land Management Field Office is part of a Programmatic Agreement (PA) that serves as an optional alternative compliance method with Section 106 of NHPA for energy related projects consisting of 39 quadrangle areas (Permian Basin Programmatic Agreement [PBPA]). This PA is a form of off-site mitigation which allows industry to pay into a mitigation fund in lieu of paying for additional archaeological inventory for projects within the designated PBPA area. Funds received from the PBPA will only be utilized to conduct archaeological research and outreach in Southeastern New Mexico.
- Air quality standards in New Mexico are under the jurisdiction of the New Mexico Environment Department/Air Quality Bureau (NMED/NMAQB). The Environmental Improvement Act, NMSA 1978, and the Air Quality Control Act, NMSA 1978, dictate state air quality standards. Also, 40 CFR § 60 “Standards of Performance for New Stationary Sources” is administered by the NMED/NMAQB.

COG Operating LLC would comply with all applicable federal, state, and local laws and regulations; obtain the necessary permits for drilling, construction, completion, and operation; and certify that Surface Use Agreements have been reached with the private landowners, where required.

## 1.6. Scoping, Public Involvement, and Issues

The Carlsbad Field Office (CFO) publishes Land Use Planning (LUP) and National Environmental Policy Act (NEPA) documents to the national register known as ePlanning, at: <https://eplanning.blm.gov>. The register allows you to review and comment online on BLM NEPA and planning documents. A hard copy of this Environmental Assessment is available for public review and comment in the Carlsbad Field Office as well as in electronic format on ePlanning, at: <https://eplanning.blm.gov/eplanning-ui/project/2011174/510>

The 30-day public comment period began September 10, 2021. The BLM will accept comments through October 12, 2021. The public can submit comments to the BLM via the following methods:

- Online submission via e-planning at the link above.
- Mail: BLM Carlsbad Field Office, Attn: Zane Kirsch, 620 E. Greene St., Carlsbad, NM 88220.
- Hand Deliver: to the Carlsbad Field Office, 7:45 a.m. – 4:30 p.m., Monday through Friday, excluding holidays.

The Council on Environmental Quality (CEQ)<sup>3</sup> regulations state: “NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail” (40 CFR § 1500.1(b)). The regulations at 40 CFR § 1500.4(g) direct 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.”

The CFO uses Geographic Information Systems (GIS) in order to identify resources that may be affected by the proposed action. A map of the project area is prepared to display the resources in the area and to identify potential issues. The proposed action was circulated among CFO resource specialists in order to identify any issues associated with the project. The issues that were raised include:

- How would air quality, including GHG emissions, be impacted by the proposed action?
- How would climate change be impacted by the proposed action?
- How would water resources be impacted by the proposed action?
- How would watershed resources be impacted by the proposed action?
- How would karst resources be impacted by the proposed action?
- How would soils be impacted by the proposed action?
- How would wildlife/habitat be impacted by the proposed action?
- How would vegetation be impacted by the proposed action?
- Could noxious weeds be introduced to the project area as a result of the proposed action?
- How would range management be impacted by the proposed action?
- How would visual resources be impacted by the proposed action?
- How would special designated areas be impacted by the proposed action?
- How would cultural resources be impacted by the proposed action?
- How would paleontological resources be impacted by the proposed action?

---

<sup>3</sup> References to the CEQ regulations throughout this EA are to the regulations in effect prior to September 14, 2020. The revised CEQ regulations effective as of September 14, 2020, are not referred to in this EA because the NEPA process associated with the Proposed Action began prior to this date.



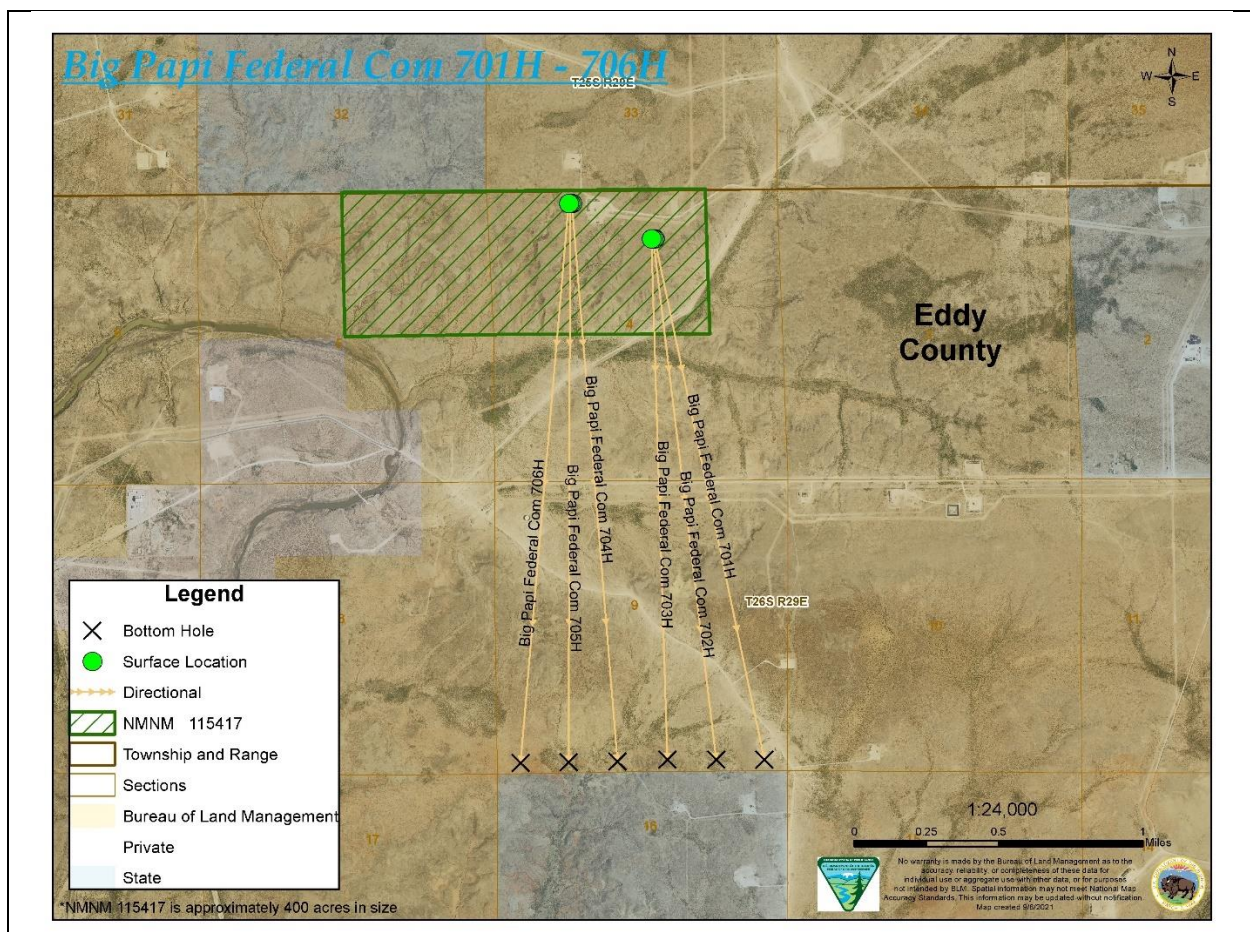
## 2. PROPOSED ACTION AND ALTERNATIVE(S)

### 2.1. Proposed Action

Under the proposed action, the BLM would approve COG Operating LLC application to construct, operate, maintain, and drill 6 horizontal oil wells from two well pads. In order to construct, operate, maintain, and drill the proposed wells with a closed loop system, two well pads would be needed one being combined with a central tank battery 630 x 400 foot surfaced and the other being 460 x 400 foot surfaced. COG Operating LLC would strip the available topsoil from the well pad area and stockpile it adjacent to the well pad edge. The well sites would then be leveled and surfaced with mineral material. COG Operating LLC would take about 30 days to drill the proposed well. After the proposed well is drilled and completed, the proposed well locations would be downsized to a 580 x 350-foot surfaced pad and a 410 x 350-foot surfaced pad. COG Operating LLC plans to construct buried pipelines. All areas not needed for production would be reclaimed by removing the caliche, recontouring the area, spreading the stockpiled topsoil over the area, and seeding the area. It is likely that the proposed well would be drilled within four years. Map 1 provides an overview of the proposed action.

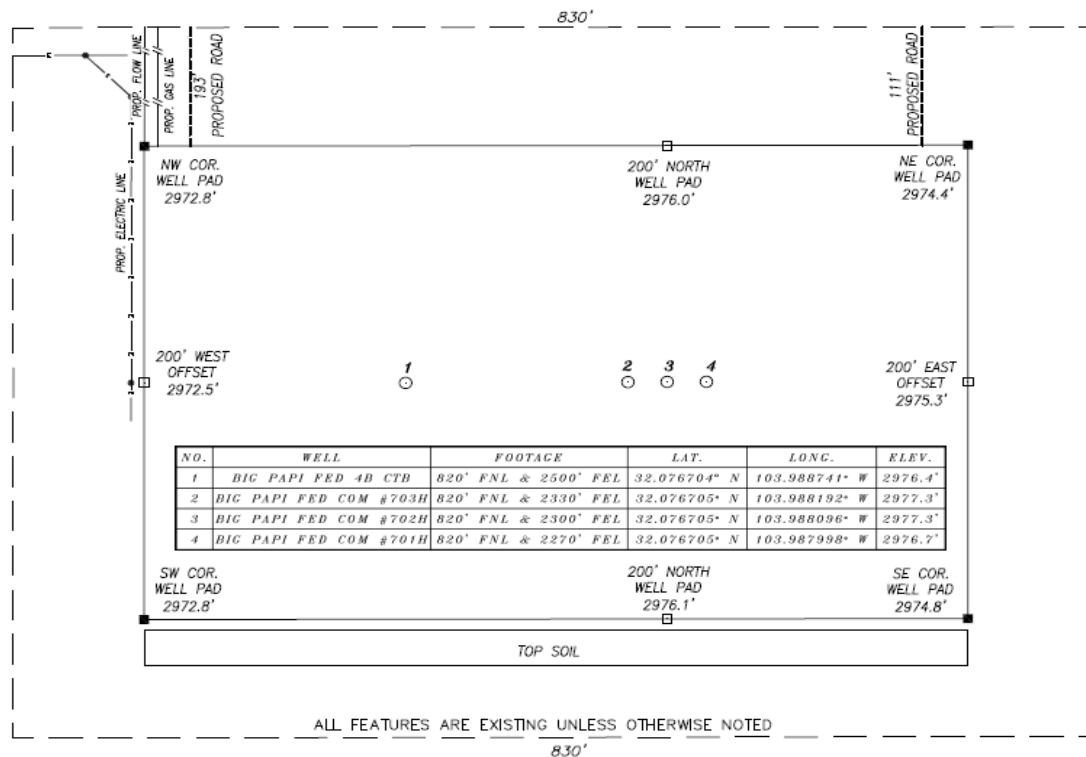
#### Proposed Lease Stipulation Waiver

In addition to approving the application, under the proposed action, the BLM would waive the Pecos River Corridor/Canyon Complex No Surface Occupancy (NSO) lease stipulation, SENM-S-11. At the time this parcel was nominated and subsequently leased, the NSO stipulation was attached erroneously, as the location of the lease parcel does not fall within the Pecos River/Canyon Complex ACEC.



**Map 1. Overview of the proposed action.**

SECTION 4, TOWNSHIP 26 SOUTH, RANGE 29 EAST, N.M.P.M.,  
EDDY COUNTY NEW MEXICO



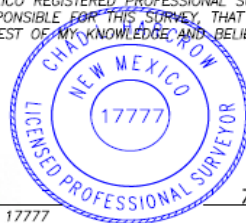
DIRECTIONS TO LOCATION

FROM THE INTERSECTION OF HIGHWAY 285 AND LONGHORN ROAD, GO EAST NORTHEAST ON LONGHORN ROAD FOR APPROX. 4.5 MILES; THEN TURN LEFT (NORTHEASTERLY) AND GO APPROX. 1.5 MILES; THEN TURN LEFT (WESTERLY) AND GO APPROX. 0.4 MILES TO THE PROPOSED ROAD; PROPOSED WELLS AND CTB LIE APPROX. 440 FEET TO THE SOUTHWEST.

COORDINATES ARE NAD 83 NME AND ELEVATIONS ARE NAVD 88

CERTIFICATION

I, CHAD HARCROW, A NEW MEXICO REGISTERED PROFESSIONAL SURVEYOR CERTIFY THAT I DIRECTED AND AM RESPONSIBLE FOR THIS SURVEY, THAT THIS SURVEY IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.



*Chad Harcrow*

CHAD HARCROW N.M.P.S. NO. 17777

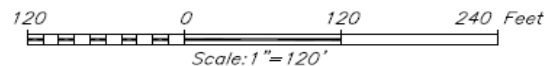
7/13/20  
DATE

HARCROW SURVEYING, LLC

2316 W. MAIN ST, ARTESIA, N.M. 88210

PH: (575) 746-2158

c.harcrow@harcrowsurveying.com

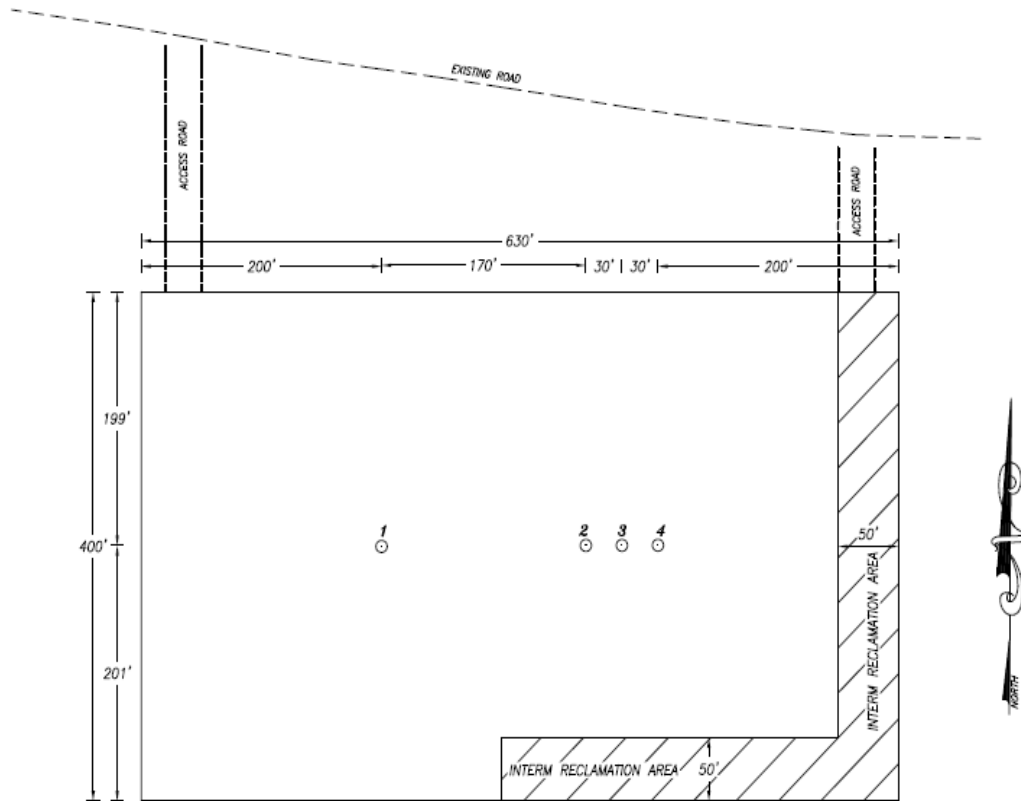


COG OPERATING, LLC

SURVEY DATE: JULY 3, 2020	600S
DRAFTING DATE: JULY 6, 2020	PAGE: 1 OF 1
APPROVED BY: CH	DRAWN BY: AH FILE: 20-922

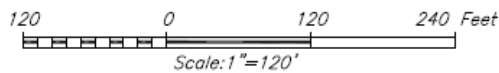


**RECLAMATION AND FACILITY DIAGRAM – PRODUCTION FACILITIES DIAGRAM**  
**COG OPERATING, LLC**  
**SECTION 4, TOWNSHIP 26 SOUTH, RANGE 29 EAST, N.M.P.M.,**  
**EDDY COUNTY, NEW MEXICO.**



NO.	WELL	FOOTAGE	LAT.	LONG.	ELEV.
1	BIG PAPI FED 4B CTB	820' FNL & 2500' FEL	32.076704° N	103.988741° W	2976.4'
2	BIG PAPI FED COM #703H	820' FNL & 2330' FEL	32.076705° N	103.988192° W	2977.3'
3	BIG PAPI FED COM #702H	820' FNL & 2300' FEL	32.076705° N	103.988096° W	2977.3'
4	BIG PAPI FED COM #701H	820' FNL & 2270' FEL	32.076705° N	103.987998° W	2976.7'

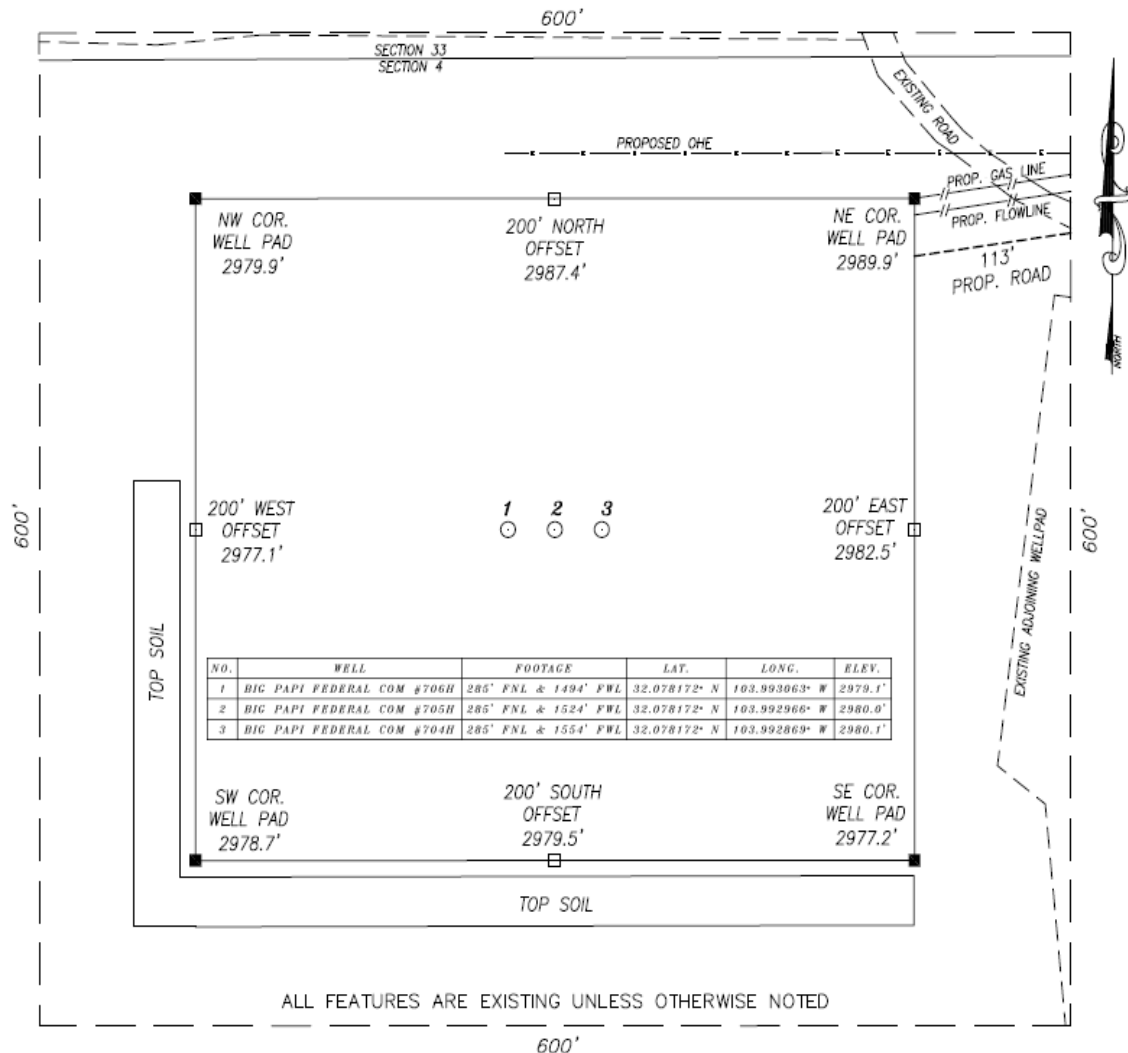
HARCROW SURVEYING, LLC  
2316 W. MAIN ST, ARTESIA, N.M. 88210  
PH: (575) 746-2158  
c.harcrow@harcrowsurveying.com



**COG OPERATING, LLC**

SURVEY DATE: JULY 3, 2020	RECLAMATION
DRAFTING DATE: JULY 7, 2020	PAGE: 1 OF 1
APPROVED BY: CH	DRAWN BY: AH FILE: 20-922

SECTION 4, TOWNSHIP 26 SOUTH, RANGE 29 EAST, N.M.P.M.,  
EDDY COUNTY NEW MEXICO



DIRECTIONS TO LOCATION  
FROM THE INTERSECTION OF HIGHWAY 285 AND LONGHORN ROAD, GO EAST NORTHEAST ON LONGHORN ROAD FOR APPROX. 4.5 MILES; THEN TURN LEFT (NORTHEASTERLY) AND GO APPROX. 1.5 MILES; THEN TURN LEFT (WESTERLY) AND GO APPROX. 0.6 MILES TO THE PROPOSED ROAD; PROPOSED WELLS LIE APPROX. 390 FEET TO THE SOUTHWEST.

COORDINATES ARE NAD 83 NME AND ELEVATIONS ARE NAVD 88

CERTIFICATION

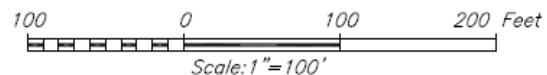
I, CHAD HARCROW, A NEW MEXICO REGISTERED PROFESSIONAL SURVEYOR CERTIFY THAT I DIRECTED AND AM RESPONSIBLE FOR THIS SURVEY, THAT THIS SURVEY IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

HARCROW SURVEYING, LLC

2316 W. MAIN ST, ARTESIA, N.M. 88210

PH: (575) 746-2158

c.harcrow@harcrowsurveying.com

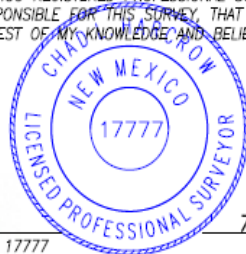


COG OPERATING, LLC

SURVEY DATE: JULY 3, 2020	600S
DRAFTING DATE: JULY 6, 2020	PAGE: 1 OF 1
APPROVED BY: CH	DRAWN BY: DS
	FILE: 20-925

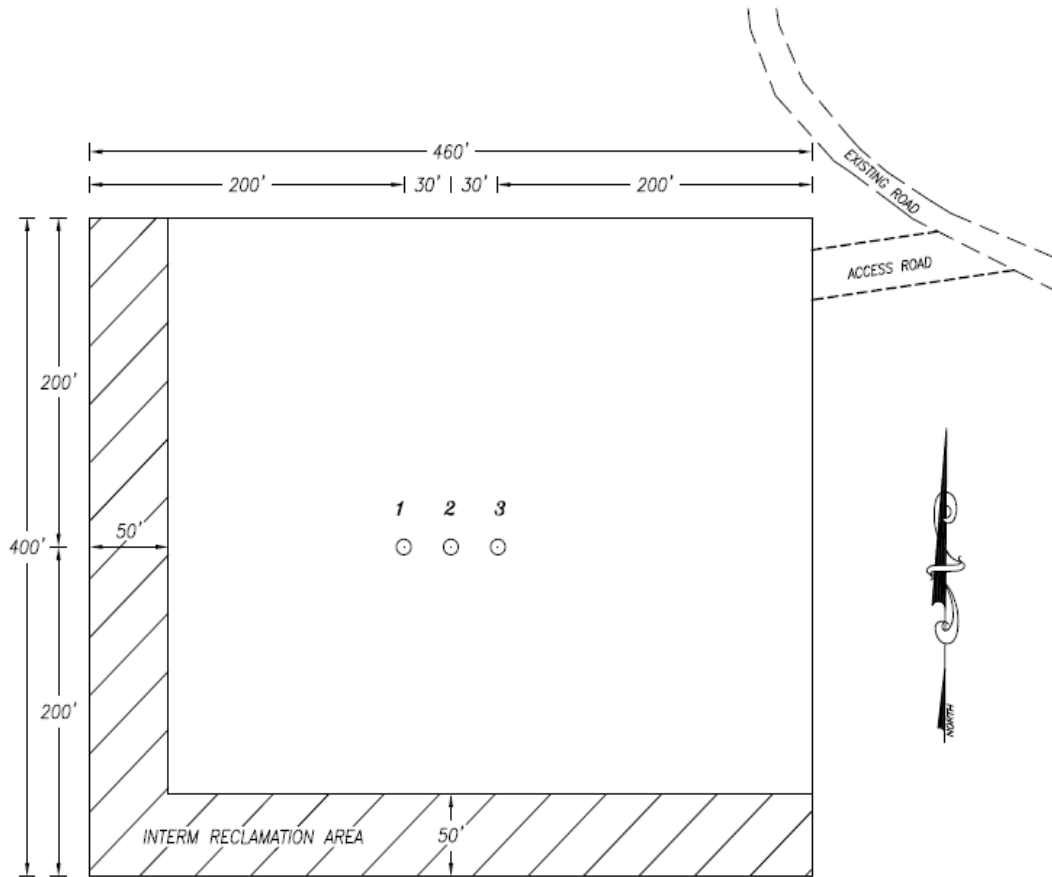
Chad Harcrow

CHAD HARCROW N.M.P.S. NO. 17777



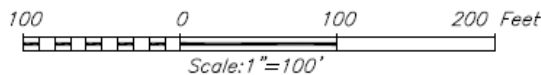
7/13/20  
DATE

RECLAMATION AND FACILITY DIAGRAM – PRODUCTION FACILITIES DIAGRAM  
 COG OPERATING, LLC  
 SECTION 4, TOWNSHIP 26 SOUTH, RANGE 29 EAST, N.M.P.M.,  
 EDDY COUNTY, NEW MEXICO.



NO.	WELL	FOOTAGE	LAT.	LONG.	ELEV.
1	BIG PAPI FEDERAL COM #706H	285' FNL & 1494' FWL	32.078172° N	103.993063° W	2979.1'
2	BIG PAPI FEDERAL COM #705H	285' FNL & 1524' FWL	32.078172° N	103.992966° W	2980.0'
3	BIG PAPI FEDERAL COM #704H	285' FNL & 1554' FWL	32.078172° N	103.992869° W	2980.1'

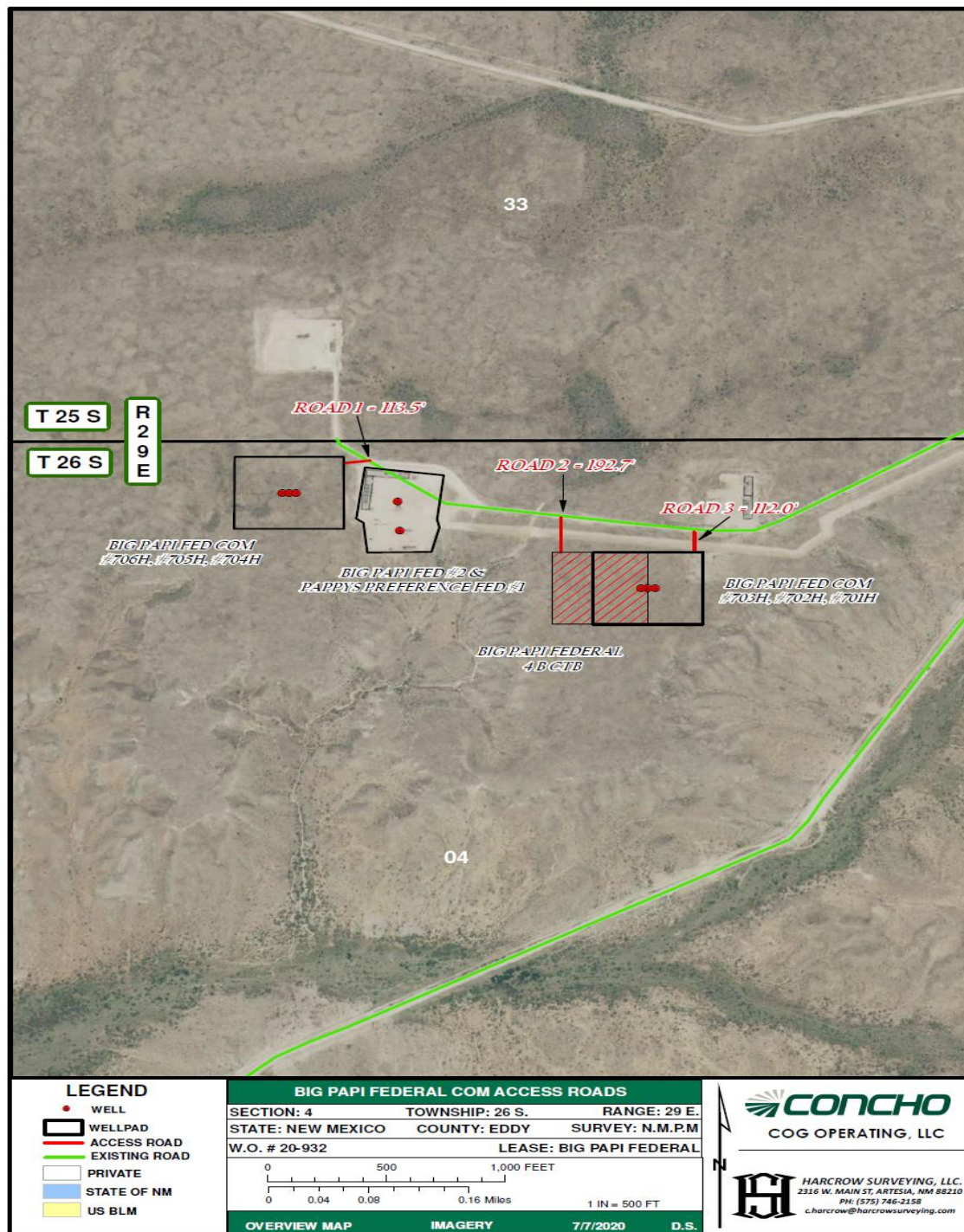
HARCROW SURVEYING, LLC  
 2316 W. MAIN ST, ARTESIA, N.M. 88210  
 PH: (575) 746-2158  
 c.harcrow@harcrowsurveying.com



COG OPERATING, LLC	
SURVEY DATE: JULY 3, 2020	RECLAMATION
DRAFTING DATE: JULY 6, 2020	PAGE: 1 OF 1
APPROVED BY: CH	DRAWN BY: DS
	FILE: 20-925

Proposed Access Road:

COG Operating LLC would need to construct about 418.2 feet of road to access the wells. The 701H-703H well pad access road would exit the northeast and northwest corner of the well/ctb location and travel north for about 192.7ft and 112 ft until it would intercept an existing lease road. The 704H-706H well pad access road would exit the northeast corner of the pad and travel east 113.5 ft until it would intercept an existing lease road. The new road would be constructed 14 ft in width, crown and ditched and surfaced with mineral material. The disturbance width for construction would be about 30 ft.

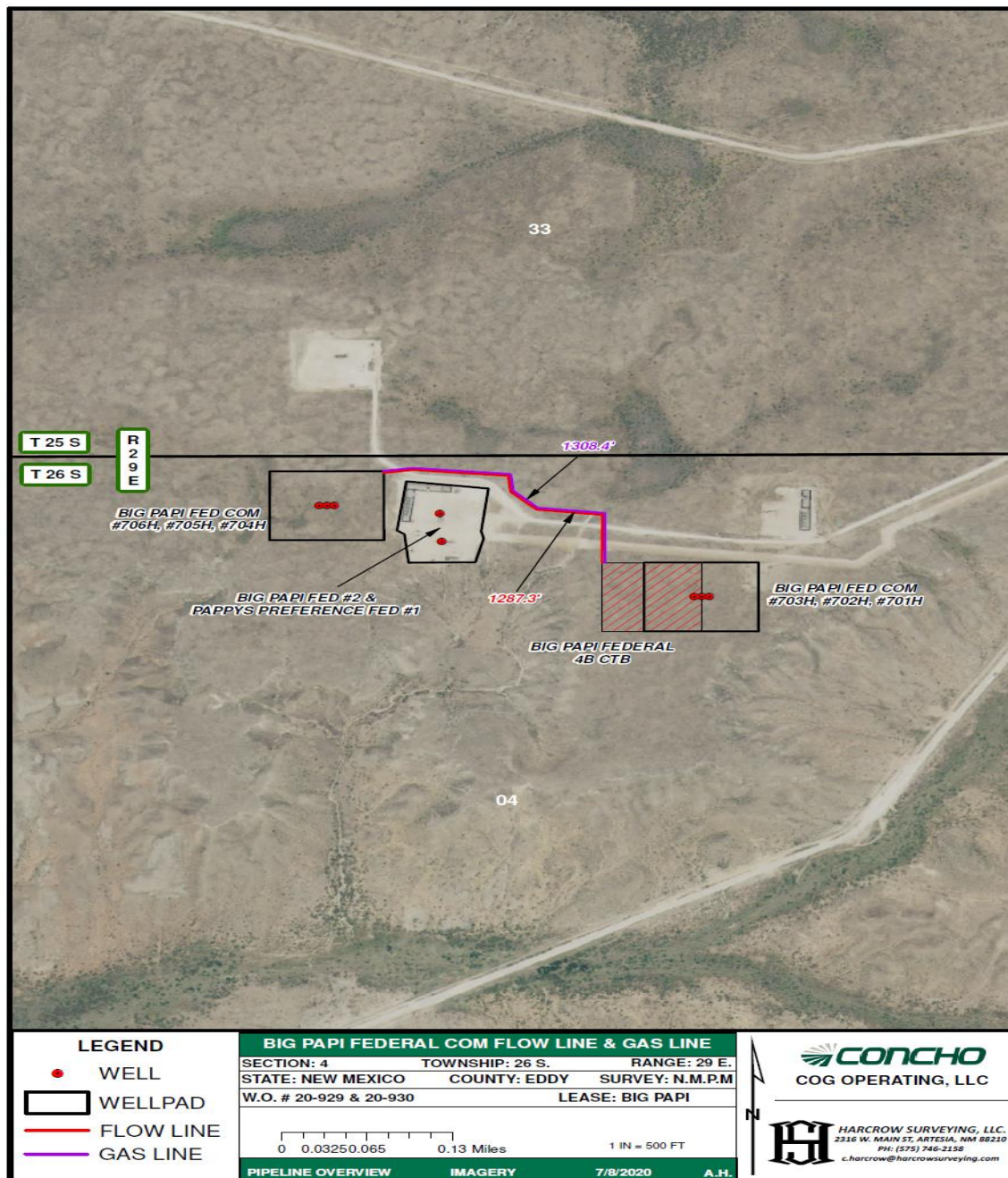




Proposed Buried Pipeline:

COG Operating LLC plans to install a two buried 4" polyethylene gas/oil pipeline from the well to the tie in point on the Big Papi Fed 4 B Central Tank Battery (CTB). The pipeline would exit off the northeast corner of the 704H-706H well location and travel east for about 1,308.4 feet along the access road until it would intercept the tie in point on the Big Papi Fed 4 B Central Tank Battery (CTB). When the pipeline would follow existing roads, the pipeline would be routed 10 feet from and parallel to the existing roads. The trench would be excavated to a depth of no less than 36". The pipeline would be placed in the trench, covered, and soil would be re-compacted. The buried 4" gas/oil pipeline length is 1,308.4 ft. and 30.0 ft. wide, for 0.90 acres.

The legal lands description is located in Eddy County, New Mexico and described as follows:



Proposed Overhead Electric Line:

COG Operating LLC plans to install an overhead electric line from the proposed wells to an existing overhead electric line. The proposed electric line from wells 701H-703H would be about 736.8 feet in length. The electric line would travel along the west side of the well location and travel north then west until it would intercept the existing electric line. The other proposed electric line from wells 704H-706H would be about 770.1 feet in length. The electric line would travel along the north side of the well location and travel east until it would intercept the existing electric line. When the electric line would follow existing roads, the electric line would be routed 20 feet from and parallel to the existing roads.

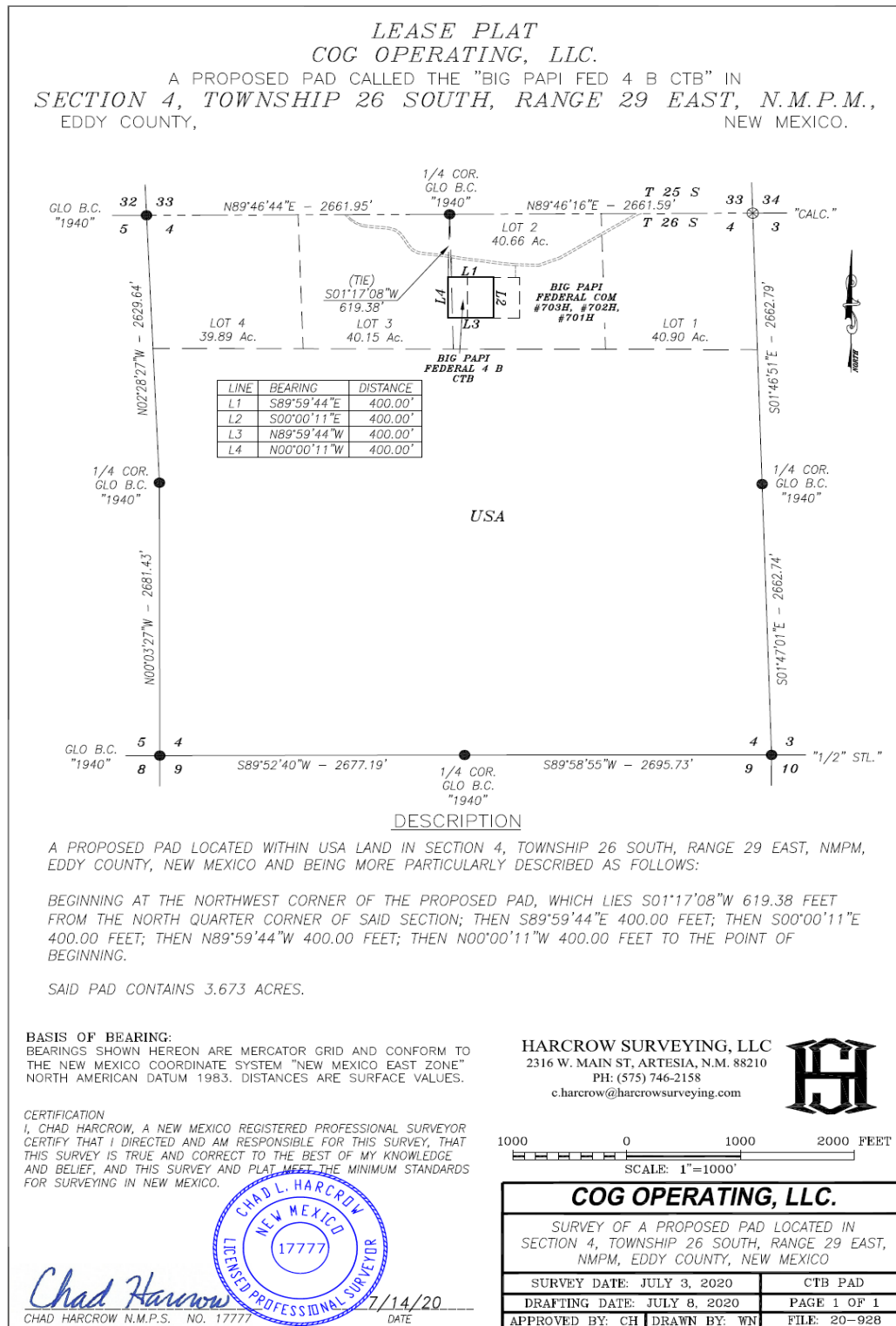
The powerline length is 1,506.9 ft. and 30.0 ft. wide, for 1.04 acres.





### Proposed Central Tank Battery

COG Operating LLC plans to construct a 400x400 central tank battery that is connected to the 701H-703H well pad to minimize disturbances. The central tank battery will be located 820' FNL & 2449' FEL Sec 4, T. 26S. R. 29E.



**Table 2-1 Proposed Action Total Surface Disturbance:**

Action	Length (ft.)	Width (ft.)	Acres
Well Pad 1/CTB	630	400	5.79
Well Pad Topsoil Stockpile	630	30	0.43
Road	418.2	30	0.29
Buried pipeline	1,308.4	30	0.90
Overhead Electric	1,506.9	30	1.04
Well Pad 2	460	400	4.22
Well Pad Topsoil Stockpile	460	30	0.32
<b>Total</b>	-	-	12.99

**Mitigation Measures:**

By BLM definition mitigation measures are not elements of the proposed action. However, mitigation measures are discussed on a resource issue specific basis in Chapter 3. As necessary based on the analysis, mitigation measures are incorporated into the APD decision as Conditions of Approval (COAs), including special requirements for Texas Hornshell; Hydrology; standard stipulations for buried pipelines, access roads and power lines.

## **2.2. No Action**

The BLM NEPA Handbook (H-1790-1) states that for externally initiated proposed actions, the No Action Alternative generally means that the proposed activity would not take place. This option is provided in 43 CFR 3162.3-1 (h) (2). This alternative would deny the approval of the proposed application, and the waiver of the Pecos River/Canyon Complex NSO lease stipulation, SENM-S-11. Existing management practices would continue to occur in the proposed project area. If the application is denied and or the lease stipulation is not waived, it is reasonably foreseeable that the lease holder would consider applying for APD for a surface hole outside of this particular lease.

## **2.3. Alternatives Considered but Eliminated from Detailed Study**

Field investigation of all areas of proposed surface disturbance for the proposed action were inspected to ensure that potential impacts to natural and cultural resources would be minimized through the implementation of mitigation measures. In addition, BLM completed onsite review of the proposed action, including determining final placement of project features that avoids and minimizes surface disturbance. Because project features were sited to avoid and minimize impacts to resources no additional alternatives for detailed analysis are necessary. To further reduce effects, mitigation measures are discussed on a resource issue specific basis in Chapter 3.

The BLM also considered issuing a lease modification or exception but found that a waiver is the appropriate mechanism, subject to the BLM NM 1203-Delegation of Authority Manual (2017), Appendix 10, Subject Code 3100, to issue a decision on the proposed lease stipulation waiver, and subject to a 30-day public involvement opportunity per 43 CFR 3101.1-4.

# **3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES**

Chapter 3 contains the impacts analysis related to the resource issues. Section 3.1 describes the effects of the No Action Alternative for all resource issues. Section 3.16 describes cumulative effects for all resource issues. The remainder of the sections in this chapter describe the potential impacts of the proposed action, related to the resource issues.

Waiving the Pecos River/Canyon Complex NSO stipulation, SENM-S-11, would remove the stipulation from the lease parcel in its entirety (400 acres). Regardless of the removal of the stipulation, the entirety of the lease would be subject to standard terms and conditions set forth in the BLM Form 3100-11, Offer

to Lease and Lease for Oil and Gas, herein referred to as standard terms and conditions, and the other stipulations attached to the lease at the time of lease issuance, such as:

- SENM-LN-1. Lease Notice for potential Cave and Karst occurrence areas
- SENM-S-17. Controlled Surface Use for Slopes or Fragile Soils
- SENM-S-18. Controlled Surface Use for Streams, River and Floodplains
- SENM-S-19. Controlled Surface Use for Playas and Alkali Lakes
- SENM-S-25. Visual Resource Management
- NM-11-LN. Special Cultural Resource Lease Notice

Effects associated with future potential development and waiving of the stipulation would be similar in nature to the effects disclosed in this chapter. The combination of topography in the area and BLM's authority under standard terms and conditions and 43 CFR 3101.1-2 would prevent development within the Pecos River Corridor, without the necessity of a stipulation specific to the area.

### **3.1. No Action Alternative for All Resource Issues**

The No Action Alternative is used as the baseline for comparison of environmental effects of the analyzed alternatives. Under the No Action Alternative, the lease stipulation would not be waived, and the proposed project would not be drilled, built or constructed and there would be no new direct or indirect impacts to natural or cultural resources from oil and gas production. Existing management would continue.

## **3.2. Air Resources**

### **3.2.1. *Affected Environment***

The analysis area for this issue is the entirety of Lea, Eddy, and Chaves counties. This analysis area was selected because data on air quality emissions are collected at a county level, and the proposed action falls within these three counties. Much of the information in this section is incorporated from the Air Resources Technical Report for BLM Oil and Gas Development in New Mexico, Kansas, Oklahoma, and Texas (herein referred to as AR Technical Report) (BLM 2018).

Methodology and assumptions for calculating air pollutants are described in the AR Technical Report. This document incorporates the sections discussing the modification of calculators developed by the BLM to address emissions for one horizontal gas well. The calculators give an approximation of criteria pollutant, hazardous air pollutants (HAPs), and GHGs emissions to be compared with regional and national emissions levels. Also incorporated into this document are the sections describing the assumptions used in developing the inputs for the calculator (BLM 2018a). One horizontal gas well was chosen to represent the most maximum estimated level of air quality criteria pollutants that would be emitted by a typical well in the New Mexico Permian Basin. Emissions for an oil well has been included in the Appendix A for comparison, in which emissions would be lower.

#### **3.1.1.1 *Air Quality***

The U.S. Environmental Protection Agency (EPA) has the primary responsibility for regulating air quality, including six nationally regulated ambient air pollutants of carbon monoxide (CO), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>), particulate matter equal to or less than 10 microns in diameter (PM<sub>10</sub>), particulate matter equal to or less than 2.5 microns in diameter (PM<sub>2.5</sub>), sulfur dioxide (SO<sub>2</sub>), and lead (Pb). The EPA has established NAAQS for criteria pollutants that are protective of human health and the environment. The EPA has approved New Mexico's State Implementation Plan and the State enforces State and Federal air quality regulations on all public and private lands.

"Design Values" are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. The most recent design values for criteria pollutants within Eddy and Lea Counties are listed below in Table 3-1 (EPA 2018). These counties do not have monitoring data for CO, Pb, and particulate matter concentrations, but because the counties are relatively rural, it is likely that these

pollutants are not elevated. Between 2014 and 2017, average estimated concentrations of PM<sub>10</sub> in Lea County were not listed and it is assumed that monitoring has been discontinued with approval from EPA because the affecting sources have been shut down.

**Table 3-1 2017 Design Values in Eddy and Lea Counties (EPA 2018)**

Pollutant	2017 Design values	Averaging Time	NAAQS	NMAAQS <sup>e</sup>
O <sub>3</sub>	0.068 parts per million (ppm) (Eddy County) 0.067 ppm (Lea County)	8-hour	0.070 ppm <sup>a</sup>	
NO <sub>2</sub>	3 parts per billion (ppb) (Eddy County) 4 ppb (Lea County)	Annual	53 ppb <sup>b</sup>	50 ppb
NO <sub>2</sub>	24 ppb (Eddy County), 32 ppb (Lea County)	1-hour	100 ppb <sup>c</sup>	
PM <sub>2.5</sub> <sup>d</sup>	9 micrograms per cubic meter (µg/m <sup>3</sup> ) (Lea County)	Annual	12 µg/m <sup>3d</sup>	
PM <sub>2.5</sub> <sup>d</sup>	17 µg/m <sup>3</sup> (Lea County)	24-hour	35 µg/m <sup>3c</sup>	

a Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years

b Not to be exceeded during the year

c 98th percentile, averaged over 3 years

d Annual mean, averaged over 3 years

e The New Mexico Ambient Air Quality Standards (NMAAQS) standard for Total Suspended Particulates (TSP), which was used as a comparison for PM<sub>10</sub> and PM<sub>2.5</sub>, was repealed as of November 30, 2018.

h While there are no NAAQS for hydrogen sulfide (H<sub>2</sub>S), New Mexico has set 1/2-hour standards for H<sub>2</sub>S at 0.100 ppm within Pecos-Permian AQ Control Region and 0.030 pp, for municipal boundaries and within five miles of municipalities with populations greater than 20,000 in areas of the state outside of the area within 5 miles of the (BLM 2018).

While all of the analysis area is in attainment of all NAAQs, including ozone, the site at 2811 Holland Street in Eddy County is the most closely watched due to the current design value of 0.068 ppm. The Carlsbad Caverns National Park is listed as having a monitor; however, the design value was not considered valid. While 0.68 is considered below the attainment value of 0.070 ppm, it is the highest design value of the monitoring stations in Eddy and Lea Counties. The potential amounts of ozone precursor emissions of nitrogen oxide(s) (NO<sub>x</sub>) and VOCs from the proposed action are not expected to impact the current design value for ozone in Chaves, Eddy, and Lea Counties; however, more information at the development stage will provide more information to better estimate air emissions from a specific project.

The Ozone Attainment Initiative is a project authorized by State Statute, 74-2-5.3 New Mexico Statutes Annotated 1978. This statute directs the New Mexico Environment Department to develop plans that may include regulations more stringent than Federal rules for areas of the state in which ambient monitoring shows ozone levels at or above 95% of the NAAQS. Currently, both Lea and Eddy Counties are within 95% of the 2015 ozone standard of 70 ppb.

Air quality in a given region can also be measured by its Air Quality Index (AQI) value. The AQI is reported according to a 500-point scale for each of the major criteria air pollutants, with the worst denominator determining the ranking. For example, if an area has a CO value of 132 on a given day and all other pollutants are below 50, the AQI for that day would be 132. The AQI scale breaks down into six categories: good (AQI <50), moderate (50–100), unhealthy for sensitive groups (100–150), unhealthy (>150), very unhealthy, and hazardous. The AQI is a national index; therefore, the air quality rating and the associated level of health concern is the same throughout the country. The AQI is an important indicator for populations sensitive to air quality changes (EPA 2018b).

AQI values for Chaves County were mainly in the good range (AQI <50) in 2017, with 94% of the days that had an AQI in that range. The median AQI in 2017 was 14, which indicates “good” air quality. The maximum AQI in 2015 was 112, which is “unhealthy for sensitive groups,” and the 90th percentile was 31.5, which is “good” air quality (EPA 2018b).

AQI values for Eddy County were generally in the good range (AQI <50) in 2017, with 67% of the days in that range and 30% of the days in the “moderate” air quality range. The median AQI in 2017 was 45, which indicates “good” air quality. The maximum AQI in 2015 was 140, which is “unhealthy for sensitive groups,” and the 90th percentile was 80, which is “moderate” air quality (EPA 2018b).

AQI values for Lea County were generally in the good range (AQI <50) in 2017, with 67 percent of the days in that range and 32% of the days in the “moderate” air quality range. The median AQI in 2017 was 45, which indicates “good” air quality. The maximum AQI in 2015 was 133, which is “unhealthy for sensitive groups,” and the 90th percentile was 68, which is “moderate” air quality (EPA 2018b). Table 3-2 lists the days where the AQI was “unhealthy for sensitive groups” or worse for the past 10 years. While there are some exceedances, the exceedances do not represent a trend of degrading AQIs.

**Table 3-2 Number of Days Classified as “Unhealthy for Sensitive Groups” (AQI 101–150) or Worse (EPA 2018b)**

Location	Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Chaves County	Days	0	0	0	0	0	1	0	0	0	1
Eddy County	Days	9	2	2	7	10	2	4	0	0	10
Lea County	Days	0	3	0	7	1	2	3	1	0	4

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 3-5 shows total human-caused emissions for each of the counties in the PDO based on EPA’s 2014 emissions inventory in tons/year (EPA 2014).

The AR 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 2018a). The EPA conducts a periodic National Air Toxics Assessment (NATA) that quantifies HAP emissions by county in the United States. The purpose of the NATA is to identify areas where HAP emissions result in high health risks and further emissions reduction strategies are necessary. The EPA has identified 187 toxic air pollutants as HAPs.

The 2005 NATA identifies census tracts with estimated total cancer risk greater than 100 in a million. There are no census tracts in New Mexico with estimated total cancer risk greater than 100 in a million. Southeastern New Mexico has a total respiratory hazard index that is among the lowest in the United States.

### **3.1.1.2 Climate Change and GHGs**

The AR Technical Report summarizes information about greenhouse gas emissions from oil and gas development and their effects on national and global climate conditions. The analysis areas associated with this proposed action are the state of New Mexico, the United States, and the globe. These geographic scales are used in this analysis to provide multiple levels of context associated with GHG emissions as a result of oil and gas development. In addition, the effects of GHG emissions are global in nature.

Climate change is a statistically significant and long-term change in climate patterns. The terms climate change and “global warming,” though often used interchangeably, are not the same. Climate change is any deviation from the average climate via warming or cooling and can result from both natural and human (anthropogenic) sources. Natural contributors to climate change include fluctuations in solar radiation, volcanic eruptions, and plate tectonics. Global warming refers to the apparent warming of climate observed since the early twentieth century and is primarily attributed to human activities such as fossil fuel combustion, industrial processes, and land use changes.

The two primary GHGs associated with the oil and gas industry are carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). CH<sub>4</sub> has a global warming potential that is 21-28 times greater than the warming potential of CO<sub>2</sub>.

The CO<sub>2</sub> equivalent (CO<sub>2e</sub>) which takes the difference in warming potential of greenhouse gases into account is reported throughout this document. For purposes of this analysis we also use a 100-year GWP of 25, parallel with the *U.S. EPA Inventory of Greenhouse Gas and Sinks* annual reporting metrics.. More information about the range of GWPs and timeframes are reported in the *AR Technical Report* and the supplemental white paper, *Cumulative BLM New Mexico Greenhouse Gas Emissions* (BLM 2018 & BLM 2019).

*The AR Technical Report* and the supplemental white paper, *Cumulative BLM New Mexico Greenhouse Gas Emissions* summarizes information about greenhouse gas emissions from past, present and reasonably foreseeable GHG emissions resulting from oil and gas development on BLM lands and their effects on national and global climate conditions (BLM 2018 & BLM 2019).

## **Social Cost of Carbon**

A protocol to estimate what is referenced as the “social cost of carbon” (SCC) associated with GHG emissions was developed by a federal Interagency Working Group (IWG), to assist agencies to meet the requirements for regulatory impact analyses during rulemakings.

The decision was made not to expand the use of the SCC protocol for this NEPA analysis for a number of reasons. Most notably, this action is not a rulemaking for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued Executive Order 13783 which, among other actions, withdrew the Technical Support Documents upon which the protocol was based and disbanded the earlier Interagency Working Group on Social Cost of Greenhouse Gases. The Order further directed agencies to ensure that estimates of the social cost of greenhouse gases used in regulatory analyses “are based on the best available science and economics” and are consistent with the guidance contained in OMB Circular A-4, “including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates” (E.O. 13783, Section 5(c)). In compliance with OMB Circular A-4, interim protocols have been developed for use in the rulemaking context. However, the Circular does not apply to project decisions.

Further, NEPA does not require a cost-benefit analysis (40 C.F.R. § 1502.23), although NEPA does require consideration of “effects” that include “economic” and “social” effects. 40 C.F.R. 1508.8(b). Without a complete monetary cost-benefit analysis, which would include the social benefits of the proposed action to society as a whole and other potential positive benefits, inclusion solely of an SCC cost analysis would be unbalanced, potentially inaccurate, and not useful in facilitating an authorized officer’s decision. Any increased economic activity, in terms of revenue, employment, labor income, total value added, and output, that is expected to occur with the proposed action is simply an economic impact, rather than an economic benefit, inasmuch as such impacts might be viewed by another person as negative or undesirable impacts due to potential increase in local population, competition for jobs, and concerns that changes in population will change the quality of the local community. Economic impact is distinct from “economic benefit” as defined in economic theory and methodology, and the socioeconomic impact analysis required under NEPA is distinct from cost-benefit analysis, which is not required.

Finally, the SCC, protocol does not measure the actual incremental impacts of a project on the environment and does not include all damages or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in carbon dioxide emissions - typically expressed as a one metric ton increase in a single year - and includes, but is not limited to, potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results “across models, over time, across regions and impact categories, and across 150,000 scenarios”. The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions. But the dollar cost figure is generated in a range and provides little benefit in assisting the BLM’s decision for project level analyses.

To summarize, SCC is not undertaken in this analysis because 1) it is not engaged in a rulemaking for which the protocol was originally developed; 2) the IWG, technical supporting documents, and associated guidance have been withdrawn; 3) NEPA does not require cost-benefit analysis; and 4) the full



social benefits of carbon-based energy production have not been monetized, and quantifying only the costs of GHG emissions but not the benefits would yield information that is both potentially inaccurate and not useful.

---

### **3.1.1 Impacts from the Proposed Action**

#### **Direct and Indirect Impacts (*Impacts, criteria Pollutants and HAPs*)**

The AR Technical Report describes the increased criteria pollutant emissions as a result of well development. The most substantial criteria pollutants emitted by oil and gas development and production are VOCs, particulate matter, and NO<sub>2</sub>. The number of proposed wells can be found in the proposed action, section 2.1 of this document. Table 3-3 shows estimated emissions and percent increases from existing conditions resulting from reasonably foreseeable well development occurring in 2019 for the Pecos District Office (PDO) planning area. The proposed action falls under the reasonably foreseeable development for the PDO Planning area and we incorporate the data as related to well development to estimate direct impacts from the proposed action (BLM 2019, Engler 2012 & SENM 2014). To facilitate quantification, this analysis assumes that all wells would be developed concurrently and in the same year, though it is more likely that future potential development would not occur in this manner. Emission calculations for construction, operations, maintenance and reclamation are included in Appendix A for a one-well oil and gas scenario.

Construction emissions for both an oil and gas well include well pad construction (fugitive dust), heavy equipment combustive emissions, commuting vehicles and wind erosion. Emissions from operations for an oil well 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. Operations emissions for a gas well include well workover operations (exhaust and fugitive dust), wellhead and compressor station fugitives, well site visits for inspection and repair, recompletions, compression, 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, blade, and track hoe equipment.

Emissions are anticipated to be at their highest level during the construction and completion phases of implementation (approximately 30 days in duration) because these phases require the highest degree of earth-moving activity, heavy equipment use, and truck traffic, compared with the operations and maintenance phases of implementation. Emissions are anticipated to decline during operations and maintenance as the need for earth-moving and heavy equipment declines.

One of the primary sources of particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) emissions is from construction during well development where dust and fine particulates are generated by on-site equipment and activities, as well as off-site vehicles (Araújo et al. 2014; Reid et al. 2010). How PM 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. Impacts of particulate matter emissions would not be confined to the construction site because PM<sub>2.5</sub> (fine particles) can travel farther in terms of distance than PM<sub>10</sub> (dust) and other total suspended particulates (particles of sizes up to 50 micrometers) and therefore can impact local residents in the surrounding area (Araújo et al. 2014). VOCs and NO<sub>2</sub> contribute to the formation of O<sub>3</sub>, which is the pollutant of most concern in southeastern New Mexico (see Table 3.1) and because O<sub>3</sub> is not a direct emission, emissions of NO<sub>x</sub> and VOCs are used as a proxy for estimating O<sub>3</sub> levels.

The supplemental white paper *Cumulative BLM New Mexico Greenhouse Gas Emissions* provides information related to the reasonably foreseeable development for the PDO Planning area. Reasonable foreseeable development (2016-2035) shows well development with an average of 320 federal wells per year and 6,400 cumulative federal wells. The number of average wells, 320, is multiplied by the pollutant emission factor from Appendix A for a gas well scenario to calculate reasonably foreseeable emissions related to well development in 2019 (Table 3-3). The BLM understands that the timing of well development varies. 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. Historically well completions since 2014 has varied from 584 completed in 2014 to 378 wells completed in 2017 (Table 3-4). Table 3-3 shows the impacts (emissions increase) associated with reasonably foreseeably well development in the PDO for 2019.

**Table 3-3 Percent Increase from Reasonable Foreseeable Development (RDF) of Oil and Gas Wells**

	Emissions (Tons per Year)					
	PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	VOC
Human-caused Current Emissions (Chaves, Eddy and Lea counties)	40,085	6,021	29,482	1,886	50,227	115,793
One well emissions <sup>a</sup>	5.31	0.81	6.19	0.11	2.63	1.17 <sup>b</sup>
<b>Total Emissions for 2019 Reasonably Foreseeable Well Development (320 wells)</b>	1699.2	259.2	1980.8	35.20	841.6	374.4
<b>Percent Increase</b>	4.23%	4.30%	6.72%	1.87%	1.68%	0.32%

<sup>a</sup> The representative well used to calculate emissions is a horizontal gas well. Emissions for vertical wells were not used from this analysis due to current predominance in horizontal technological drilling methods and because presenting horizontal gas wells emissions estimates represents a more conservative summary of emissions, compared with emissions from a vertical well, with the exception of SO<sub>2</sub>, which could be 4 to 5 times greater in a vertical well scenario. However, sulfur dioxide emissions are still estimated to be within the same magnitude and less <1 ton per year of SO<sub>2</sub> emissions per well. See Appendix A for additional discussion of emission factors.

<sup>b</sup> VOC emissions at the operational phase represent a 95% control efficiency and estimates potential emissions representing the contribution for “one oil well” from the emissions at storage tanks, gathering facilities, etc.

While impacts to air quality on a broad-scale in the analysis area show an addition of 6.72% and approximately 4% for NO<sub>x</sub> and PM respectively, the proposed action would result in even smaller individualized impacts as development would not occur at the same time and in the same space but over a span of time. Localized and short term impacts to air quality for nearby residences from emissions of particulate matter, NO<sub>x</sub>, VOCs, and HAPs is expected. Under the Proposed Action, the additional NO<sub>x</sub> and VOCs emitted from the oil and gas wells are anticipated to be too small in quantity to result in exceedances of O<sub>3</sub> in the analysis area. This incremental addition would not be expected to result in an exceedance of the NAAQS or State air quality standards for any criteria pollutants in the analysis area because the addition of criteria pollutants and VOCs, as shown in Table 3-3 are scaled down to the proposed action level.

### **Hazardous Air Pollutants (HAPs)**

The formulas used for calculating HAPs in the calculators are very imprecise. For many processes it is assumed that emission of HAPs will be equivalent to 10% of VOC emissions. Therefore the HAP emissions reported here should be considered a very gross estimate and likely an overestimate. The calculator estimates that a maximum of 37.44 tons/year of HAPs would be emitted during the construction, and first year of operation during the development of 320 wells using emission factors from a gas well in the Permian Basin. The emissions are a combination of HAP constituents existing in natural gas and released during the completion and operation process. Most gas vented during the completion process is flared, which substantially reduces the quantity of HAPs released.

### **Impacts Climate Change and GHGs**

Climate change is a global process that is impacted by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from a proposed land management action cannot be accurately translated into effects on climate change globally or in the area of any site-specific action. Currently, Global Climate Models are unable to forecast local or regional effects on resources (IPCC

2013). However, there are general projections regarding potential impacts to natural resources and plant and animal species that may be attributed to climate change from GHG emissions over time; however these effects are likely to be varied, including those in the southwestern United States (Karl, 2009).

Climate change projections are based on a hierarchy of climate models that range from simple to complex, coupled with comprehensive Earth System Models. Additional near-term warming is inevitable due to the thermal inertia of the oceans and ongoing GHG emissions. A more detailed discussion of climate change and the relationship of GHGs to climate change as well as the intensity and effects on national and global climate is presented in the AR Technical Report and the supplemental white paper, *Cumulative BLM New Mexico Greenhouse Gas Emissions* (BLM 2018 & BLM 2019).

Analysis of the impacts of the proposed action using GHG emissions as a proxy for impacts are reported below in Table 3-4. Direct impacts of the proposed action are the result of well development activities that includes drill rig operations, workover operations (exhaust), recompletion traffic, venting, compression and well pumps, dehydrators and compression station fugitives as well as other sources that generate carbon dioxide, methane, nitrous oxide.

The *Cumulative BLM New Mexico Greenhouse Gas Emissions* provides information related to the reasonably foreseeable development for the BLM PDO Planning area. Reasonable foreseeable development (2016-2035) shows an average of 320 federal wells per year could be developed and 6,400 cumulative federal wells. Reasonably foreseeable oil and gas production is also provided where total cumulative federal production would result in 1116.73 MMT of CO<sub>2</sub>e over the life of the RFD (BLM 2019). In 2019, RFD volumes show indirect GHG emissions would be emitted from 79.39 MMbbls of oil and 304,935 MMcf of gas. This proposed action falls under the reasonably foreseeable development and end-use combustion of oil and gas for the PDO area and we incorporate the data as related to well development and production volumes to estimate direct and indirect GHG impacts from the proposed action (Engler 2012 & SENM 2014). The proposed action will yield approximately 795,000 barrels of oil equivalent (BOE) for every horizontal well completed in the Bone Spring Sand and 1,116,000 BOE for per well drilled in the Wolfcamp Shale (Mire and Moomaw 2017). The proposed action would result in end use combustion emissions of 341,850 MT of CO<sub>2</sub>e per Bone Spring Sand well and 479,880 MT of CO<sub>2</sub>e for per Wolfcamp Shale Well.

Historically well completions since 2014 has varied from 584 completed in 2014 to 378 wells completed in 2017 (Table 3-4). Table 3-4 also shows the direct GHG emissions associated with reasonably foreseeable well development in the Pecos District Office for 2019. GHG emission calculations for construction, operations, maintenance and reclamation are included in Appendix A for a one-oil and gas well scenario. The AR Technical report provides annual updates to actual well completions in the Pecos District Office in which we then associate the GHG emission factor from Appendix A to the number of well completions per year. Table 3-5 presents indirect end-use GHG emissions for the United States, New Mexico as well as the major BLM federal oil and gas basins associated with the reasonably foreseeable production of oil and gas. A discussion of the methodology and assumptions for this data is contained in the *Cumulative BLM New Mexico Greenhouse Gas Emissions* (BLM 2019). The proposed action falls under the reasonably foreseeable development for the PDO area, and we incorporate the data as related to production data to calculate indirect impacts from the proposed action (Engler 2012 & SENM 2014). Historically CO<sub>2</sub>e emissions from federal oil and gas production for the PDO has varied from 40.10 MMT of CO<sub>2</sub>e/year in 2014 to 48.85 MMT of CO<sub>2</sub>e/year in 2017. The reasonably foreseeable indirect GHG emissions resulting from oil and gas well development in 2019 is estimated at 50.82 MMT CO<sub>2</sub>e/year (Table 3-4).

**Table 3-4 Well Completions and estimated GHG emissions based on APD Activity**

<b>Pecos District Office</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>BLM 2019 RFD</b>	<b>BLM RFD (2016-2035)</b>
# of BLM Well Completions*	584	400	389	378	518	320	6,400
Metric Tons of CO <sub>2</sub> e/year	731,517	501,039	487,260	473,482	648,846	400,831	8,016,624

\*Emission factor (metric tons of CO<sub>2</sub>e per well) is from Tables A 1-2 of Appendix A

# of BLM federal & non-federal wells in PDO RFD (2016-2037) is 16,000.

\*PDO BLM wells Includes completions from Carlsbad, Hobbs and Roswell Field Offices

\*Wells completed reported from AFMSS 1&2 with run date June 20, 2019.

**Table 3-5 Historical oil and gas production and Reasonably Foreseeable Development**

<b>Oil and Gas Production</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>RFD</b>
U.S. Oil Production (Mbbls) <sup>1</sup>	3,196,889	3,442,188	3,232,025	3,413,376	3,639,277
New Mexico Oil Production (Mbbls)	125,021	147,663	146,389	171,440	*
PDO Oil Production (Mbbls)	62,007	73,344	74,810	76,307	79,389
FFO Oil Production (Mbbls)	5,755	8,457	6,889	5,980	5,451
U.S. Gas Production (MMcf) <sup>1</sup>	25,889,605	27,065,460	26,592,115	27,291,222	30,743,208
New Mexico Gas Production (MMcf)	1,140,626	1,151,493	1,139,826	1,196,514	*
PDO Gas Production (MMcf)	245,550	281,713	287,347	293,094	304,935
FFO Gas Production (MMcf)	664,211	642,211	596,747	464,709	196,868
<b>GHG Emissions</b>					
Total U.S. O&G GHG Emissions (MMT CO <sub>2</sub> e) <sup>1</sup>	2791.29	2961.11	2844.84	2961.08	3,247
Total New Mexico O&G GHG Emissions (MMT CO <sub>2</sub> e)	116.17	126.50	125.32	139.19	138.9
Total PDO O&G GHG Emissions (MMT CO <sub>2</sub> e)	40.10	46.95	47.89	48.85	50.82
Total FFO O&G GHG Emissions (MMT CO <sub>2</sub> e)	38.82	38.78	35.62	28.00	13.12

<sup>1</sup> RFD for the U.S. data projects productions volumes based on year 2020.

\*The RFD for New Mexico production is for year 2020. Production volumes to estimate total GHGs use both production and consumption volumes using data from Golder Associates 2017. The methodology can be found in this report.

### ***Cumulative Impacts Criteria Pollutants, HAPs and GHGs***

Activities that contribute to levels of air pollutant and GHG emissions in the Permian Basin include fossil fuel industries, vehicle travel, industrial construction, potash mining, and others. A complete inventory of criteria pollutant emissions can be found in a report titled “Southeast New Mexico Inventory of Air Pollutant Emissions and Cumulative Air Impact Analysis 2007” (AES 2011). The AR Technical Report includes a description of the varied sources of national and regional emissions that are incorporated here to represent the past, present and reasonably foreseeable impacts to air resources (BLM, 2018). It includes a summary of emissions on the national and regional scale by industry source. Sources that are considered to have notable contributions to air quality impacts and GHG emissions include electrical generating units, fossil fuel production (nationally and regionally), and transportation.

The AR Technical Report discusses the relationship of past, present, and future predicted emissions to climate change and the limitations in predicting local and regional impacts related to emissions. It is currently not feasible to know with certainty the net impacts from particular emissions associated with activities on public lands. However, the small incremental increase in GHGs from this project will not have a measurable impact on climate. Because GHGs affect climate change and climate change is a result various processes occurring in tandem with other global processes, in analyzing direct and indirect impacts we also analyze for cumulative impacts.

The emissions calculator estimated that there could be small direct increases in several criteria pollutants, HAPs, and GHGs as a result of the proposed action. The small increase in emissions that could result

from approval of the proposed action would not result in Eddy, Lea, or Chavez County exceeding the NAAQS for any criteria pollutants. The applicable regulatory threshold for HAPs is the oil and gas industry National Emissions Standards for Hazardous Air Pollutants, which are currently under review by the EPA. The emissions from the proposed well are not expected to impact the 8-hour average ozone concentrations, or any other criteria pollutants in the Permian Basin.

### **Mitigation Measures and Residual Impacts**

A discussion on mitigation measures can be found in the section of Cumulative BLM New Mexico Greenhouse Gas Emissions, A Supplemental White Paper.

## **3.3. Water Resources**

The BLM Pecos District Office, which oversees the Carlsbad and Roswell Field Offices and the Hobbs Field Station, encompasses over 3.5 million acres of public lands and over 7 million acres of Federal mineral estate. The Pecos District includes the New Mexico portion of the Permian Basin, a sedimentary depositional basin. The Permian Basin is one of the premier oil and gas producing regions in the United States (U.S.), and prolific producing horizons occur in the New Mexico portion of the basin in Eddy and Lea Counties. The Permian Basin has been a producing oil and natural gas field since the early 1900s. There are approximately 15,660 active Federal wells are within the boundary of the Pecos District.

This section presents information on existing and projected water quantity and water quality data for the Pecos District as summarized from information gathered from the Reasonable Foreseeable Development (RFD) Scenario for the BLM. New Mexico Pecos District (Engler and Cather 2012) and 2014, and data compiled from a 2015 USGS report, Estimate Use of Water in the United States in 2015 (Dieter et. al. 2018), and FracFocus, a national hydraulic fracturing chemical registry managed by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission (FracFocus 2018).

---

### **3.3.1. Affected Environment**

#### ***Water Quantity***

##### **Existing Surface and Ground Water Use in the Pecos District**

The 2015 USGS Report, Estimate 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. Tables 3.6 through Table 3.8 list the total 2015 water withdrawals in for the eight water use categories for each of the three counties within the Pecos District ("Pecos District Tri-County Area"). Table 3-9 presents combined water use for the Pecos District Tri-County Area. This area is roughly analogous to the New Mexico portion of the Permian Basin. As shown in the tables, Irrigation is the largest category of water use in all counties, accounting for an average of 75 percent (466,784 acre-feet ([AF]) of the total water withdrawal for the Pecos District Tri-County Area (619,375 AF). Approximately 88 percent (545,154 AF) of the total water use for Pecos District Tri-County Area is from groundwater. Mining (which includes oil and gas development) comprises approximately 15 percent of Pecos District Tri-County Area water withdrawals. All mining-related water use (94,758 AF) is from groundwater. Of that total, 99 percent of withdrawals are from saline sources. Most (87 percent) mining-related water use occurs in Lea County, where mining comprises 31 percent of the total county withdrawals. The relative use of water by industry within the Pecos District Tri-County Area is depicted in Figure 1. The relative use of surface water and fresh/ saline groundwater by industry within the Pecos District Tri-County Area is depicted in Figure 2.

**Table 3-6 Lea County 2015 Water Use by Category (af/yr)**

Category	Surface Water				Groundwater				Total Withdrawals					
	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	Percent Total Use	AF Saline	Percent Total Use	AF Total	Percent Total Use
Public Water Supply	0	0	0	0%	11,423	0	11,423	100%	11,423	100%	0	0%	11,423	4%
Industrial	0	0	0	0%	78	0	78	100%	78	100%	0	0%	78	0%
Irrigation	0	0	0	0%	166,099	0	166,099	100%	166,099	100%	0	0%	166,099	62%
Livestock	56	0	56	2%	2,870	0	2,870	98%	2,926	100%	0	0%	2,926	1%
Aquaculture	0	0	0	0%	0	0	0	0%	0	0%	0	0%	0	0%
Mining	0	0	0	0%	325	81,642	81,968	100%	325	0.4%	81,642	99.6%	81,968	31%
Thermoelectric power	0	0	0	0%	1,827	0	1,827	100%	1,827	100%	0	0%	1,827	1%
Domestic	0	0	0	0%	1,513	0	1,513	100%	1,513	100%	0	0%	1,513	1%
<b>County Totals</b>	<b>56</b>	<b>0</b>	<b>56</b>	<b>0%</b>	<b>184,136</b>	<b>81,642</b>	<b>265,778</b>	<b>100%</b>	<b>184,192</b>	<b>69%</b>	<b>81,642</b>	<b>31%</b>	<b>265,834</b>	<b>100%</b>

Source: Dieter et al. 2017.

**Table 3-7 Eddy County 2015 Water Use by Category (af/yr)**

Category	Surface Water				Groundwater				Total Withdrawals					
	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	Percent Total Use	AF Saline	Percent Total Use	AF Total	Percent Total Use
Public Water Supply	0	0	0	0%	15,077	0	15,077	100%	15,077	100%	0	0%	15,077	8%
Industrial	0	0	0	0%	1,043	0	1,043	100%	1,043	100%	0	0%	1,043	1%
Irrigation	64,054	0	64,054	42%	89,994	0	89,994	58%	154,048	100%	0	0%	154,048	84%
Livestock	34	0	34	3%	1,289	0	1,289	97%	1,323	100%	0	0%	1,323	1%
Aquaculture	0	0	0	0%	0	0	0	0%	0	0%	0	0%	0	0%
Mining	0	0	0	0%	1,169	10,993	12,162	100%	1,169	10%	10,993	90%	12,162	6%
Thermoelectric power	0	0	0	0%	0	0	0	0%	0	0%	0	0%	0	0%
Domestic	0	0	0	0%	258	0	258	100%	258	100%	0	0%	258	0%
<b>County Totals</b>	<b>64,088</b>	<b>0</b>	<b>64,088</b>	<b>35%</b>	<b>108,830</b>	<b>10,993</b>	<b>119,823</b>	<b>65%</b>	<b>172,918</b>	<b>94%</b>	<b>10,993</b>	<b>6%</b>	<b>183,910</b>	<b>100%</b>

Source: Dieter et al. 2017.



**Table 3-8 Chavez County 2015 Water Use by Category (af/yr)**

Category	Surface Water				Groundwater				Total Withdrawals					
	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	Percent Total Use	AF Saline	Percent Total Use	AF Total	Percent Total Use
Public Water Supply	0	0	0	0%	12,970	0	12,970	100%	12,970	100%	0	0	12,970	8%
Industrial	0	0	0	0%	0	0	0	0%	0	0%	0	0%	0	0%
Irrigation	9,854	0	9,854	7%	136,784	0	136,784	93%	146,638	100%	0	0%	146,638	86%
Livestock	224	0	224	3%	6,378	0	6,378	97%	6,603	100%	0	0%	6,603	4%
Aquaculture	0	0	0	0%	1,782	0	1,782	100%	1,782	100%	0	0%	1,782	1%
Mining	0	0	0	0%	78	1,592	1,670	100%	78	5%	1,592	95%	1,670	1%
Thermoelectric power	0	0	0	0%	0	0	0	0%	0	0%	0	0%	0	0%
Domestic	0	0	0	0%	1,009	0	1,009	100%	1,009	100%	0	0%	1,009	1%
<b>County Totals</b>	<b>10,078</b>	<b>0</b>	<b>10,078</b>	<b>6%</b>	<b>159,003</b>	<b>1,592</b>	<b>160,594</b>	<b>94%</b>	<b>169,080</b>	<b>99%</b>	<b>1,592</b>	<b>1%</b>	<b>170,672</b>	<b>100%</b>

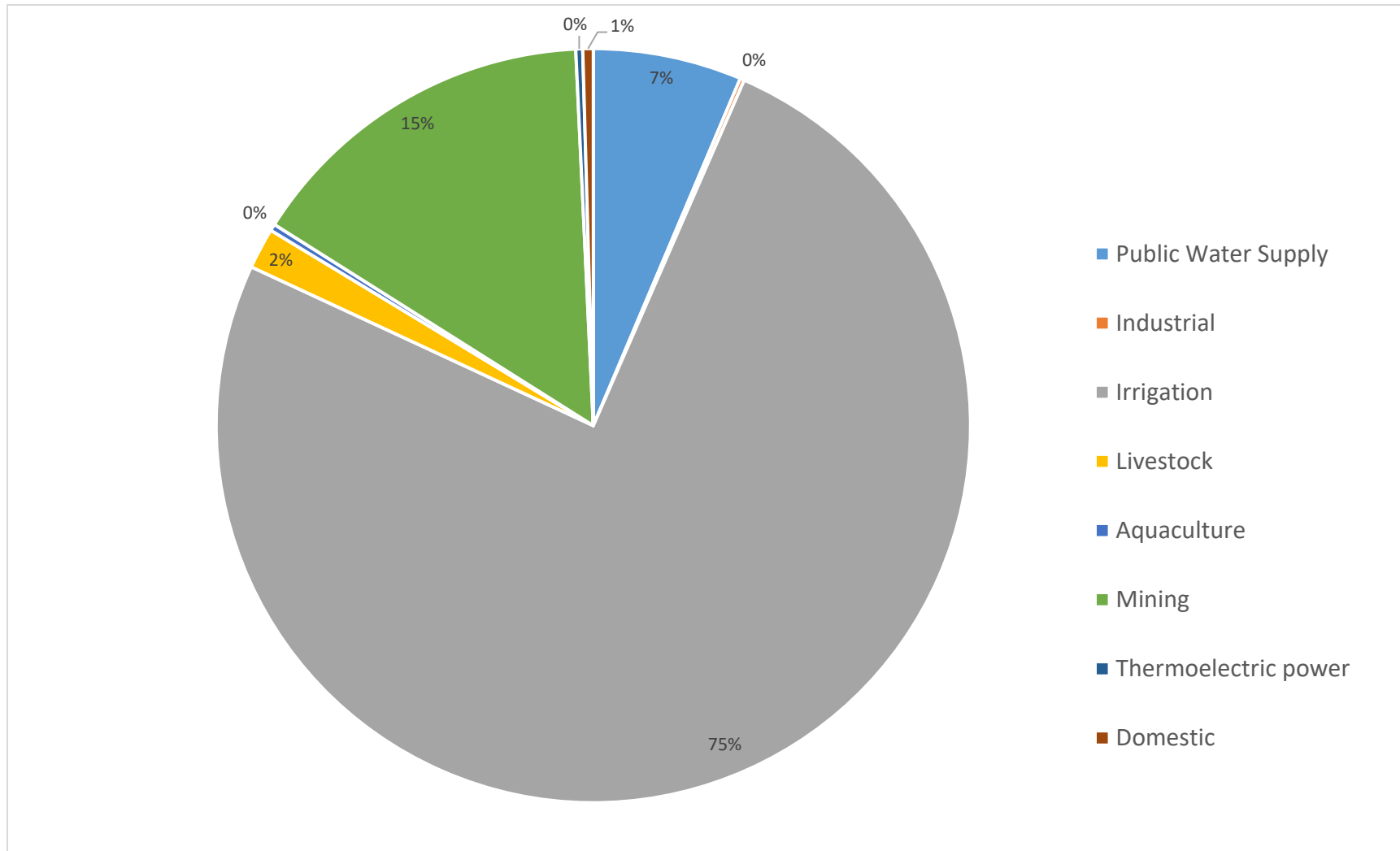
Source: Dieter et al. 2017.

**Table 3-9 Pecos District Tri-County Area 2015 Water Use by Category (af/yr)**

Category	Surface Water				Groundwater				Total Withdrawals					
	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	Percent Total Use	AF Saline	Percent Total Use	AF Total	Percent Total Use
Public Water Supply	-	-	-	0%	39,470	-	39,470	100%	39,470	100%	0	0	39,470	6%
Industrial	-	-	-	0%	1,121	-	1,121	100%	1,121	100%	0	0%	1,121	0%
Irrigation	73,908	-	73,908	16%	392,877	-	392,877	84%	466,784	100%	0	0%	466,784	75%
Livestock	314	-	314	3%	10,537	-	10,537	97%	10,851	100%	0	0%	10,851	2%
Aquaculture	-	-	-	0%	1,782	-	1,782	100%	1,782	100%	0	0%	1,782	0%
Mining	-	-	-	0%	1,573	94,227	95,800	100%	1,573	1%	24,227	99%	95,800	15%
Thermoelectric power	-	-	-	0%	1,827	-	1,827	100%	1,827	100%	0	0%	1,827	0%
Domestic	-	-	-	0%	2,780	-	2,780	100%	2,780	100%	0	0%	2,780	0%
<b>District Totals</b>	<b>74,221</b>	<b>-</b>	<b>74,221</b>	<b>12%</b>	<b>451,968</b>	<b>24,227</b>	<b>546,195</b>	<b>88%</b>	<b>526,195</b>	<b>85%</b>	<b>24,227</b>	<b>15%</b>	<b>620,416</b>	<b>100%</b>

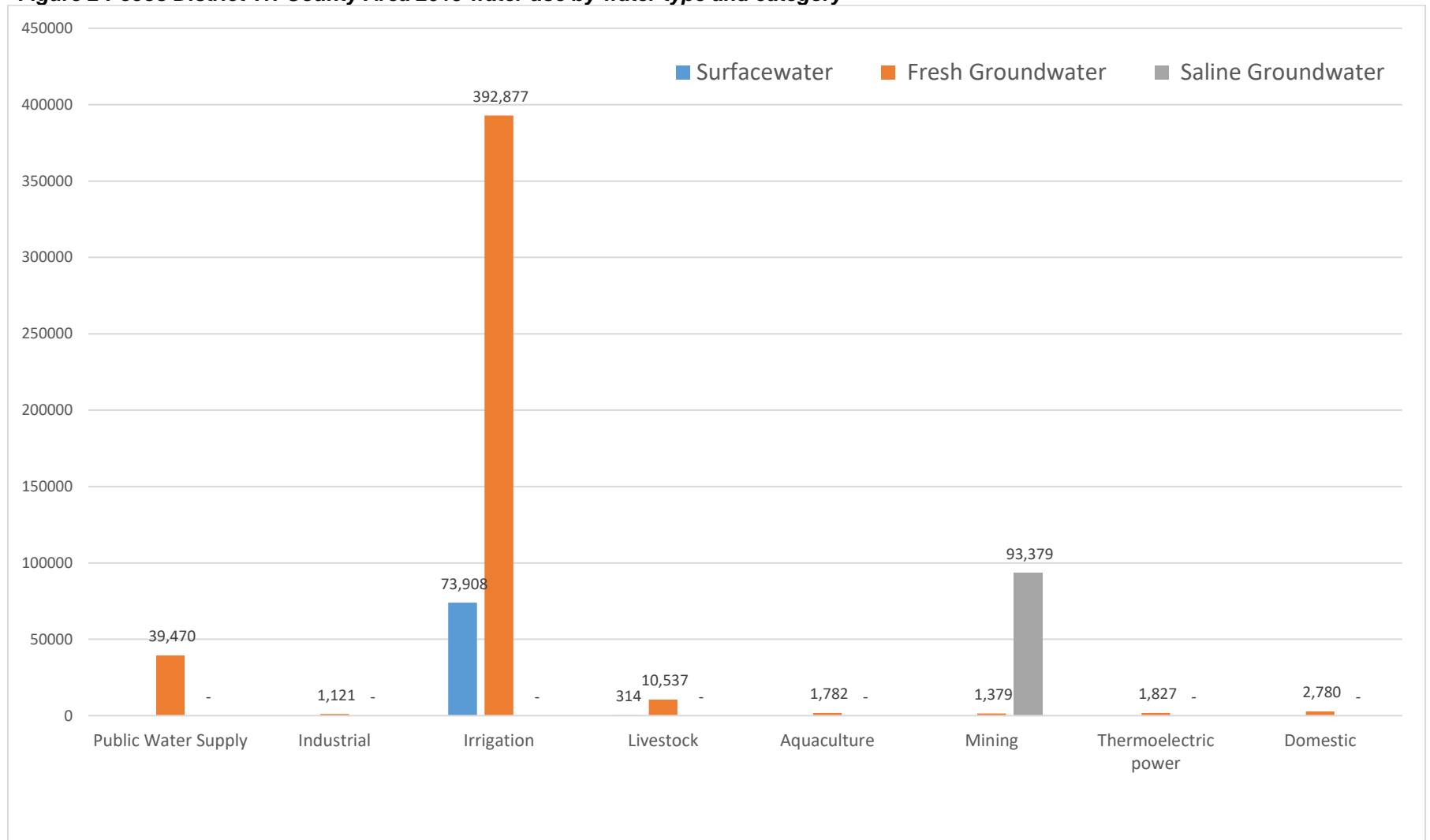
Source: Dieter et al. 2017.

**Figure 1 Pecos District Tri-County Area 2015 water use by category**



Source: Dieter et al. 2017.

**Figure 2 Pecos District Tri-County Area 2015 water use by water type and category**



Source: Dieter et al. 2017.

## State of New Mexico Water Use

In 2015, withdrawals for all water use categories across the State of New Mexico totaled 3,249,667 AF (USGS 2015). Pecos District Tri-County Area total water usage (619,375 AF) accounted for about 19 percent of the total state withdrawals. Table 3-10 lists the water for the major categories in New Mexico. As shown in the table, Mining water withdrawals totaled 163,901 AF, or about 5 percent of the total water withdrawals for the State of New Mexico. While the data presented in this table are for the state as a whole; most water use in this category is from the Permian Basin with some water use from the San Juan Basin. Table 3-11 presents water use associated with oil and gas development in New Mexico, by county. As shown in the table, over 99 percent of the water use associated with oil and gas development occurs in the Pecos District Tri-County Area (3,994 AF). Water use associated with oil and gas development comprises approximately 2.5 percent of the statewide Mining water use (163,901 AF, see Table 3-10) and 4.2% of the Pecos District Tri-County Area Mining water use (94,758 AF, see Table 3-9).

**Table 3-10 State of New Mexico Use by Category (AF/yr)**

Category	Surface Water				Groundwater				Total Withdrawals					
	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	AF Saline	AF Total	Percent Total Use	AF Fresh	Percent Total Use	AF Saline	Percent Total Use	AF Total	Percent Total Use
Public Water Supply	87,752	-	87,752	30%	205,715	-	205,715	70%	293,467	100%	-	-	293,467	9%
Industrial	-	-	-	0%	3,811	-	3,811	100%	3,811	100%	-	-	3,811	0%
Irrigation	1,485,112	-	1,485,112	56%	1,175,312	-	1,175,312	44%	2,660,424	100%	-	-	2,660,424	82%
Livestock	2,522	-	2,522	7%	33,372	-	33,372	93%	35,894	100%	-	-	35,894	1%
Aquaculture	6,109	-	6,109	23%	20,929	-	20,929	77%	27,039	100%	-	-	27,039	1%
Mining†	19,550	-	19,550	12%	44,111	100,240	144,351	88%	63,662	39%	100,240	61%	163,901	5%
Thermoelectric power	30,637	-	30,637	82%	6,872	-	6,872	18%	37,509	100%	-	-	37,509	1%
Domestic	-	-	-	0%	27,621	-	27,621	100%	27,621	100%	-	-	27,621	1%
<b>Totals</b>	<b>1,631,683</b>	<b>-</b>	<b>1,631,683</b>	<b>50%</b>	<b>1,517,744</b>	<b>100,240</b>	<b>1,617,984</b>	<b>50%</b>	<b>3,149,427</b>	<b>97%</b>	<b>100,240</b>	<b>3%</b>	<b>3,249,667</b>	<b>100%</b>

Source: Source: Dieter et al. 2017; updated with additional information provided to the BLM from the NMOSE regarding water use of the Navajo Power Plant (BLM 2019).

† Approximately 19,550 AF of the freshwater use within the Mining industry is from surface water; the remainder of all other water use is from groundwater. The Mining category includes the following self-supplied enterprises that extract minerals occurring naturally in the earth's crust: solids, such as potash, coal, and smelting ores; liquids, such as crude petroleum; and gases, such as natural gas. This category includes water used for oil and gas production (well drilling and secondary recovery of oil), quarrying, milling (crushing, screening, washing, flotation, etc.), and other processing done at the mine site or as part of a mining activity, as well as water removed from underground excavations (mine dewatering) and stored in—and evaporated from—tailings ponds. The Mining category also includes water used to irrigate new vegetative covers at former mine sites that have been reclaimed. It does not include the processing of raw materials, such as smelting ores, unless this activity occurs as an integral part of a mining operation and is included in an NMOSE permit.

**Table 3-11 2015 State of New Mexico Water Use Associated with Oil and Gas Development (AF/yr)**

County	Surface Water	Groundwater	Total	Percent of Total
Bernalillo	0	7	7	0%
Chaves	0	84	84	2%
Eddy	0	2,635	2,635	65%
Lea	0	1,275	1,275	32%
San Juan	30	0	30	1%
Sierra	0	1	1	0%
<b>State Total</b>	<b>30</b>	<b>4,002</b>	<b>4,032</b>	<b>100%</b>

NMOSE 2019.

### ***Water Use Associated with Reasonably Foreseeable Oil and Gas Development***

The reasonable foreseeable development (RFD) scenario for the BLM New Mexico Pecos District (Engler and Cather 2012, 2013, 2014) was developed as a reasonable estimate of development associated with hydrocarbon production in southeast New Mexico for the next 20 years in the New Mexico portion of the Permian Basin. The RFD is a comprehensive study of all existing plays and an analysis of recent activity, historical production, emerging plays for future potential, and completion trends. Table 3-12 presents planning factors from the RFD.

**Table 3-12 RFD Planning Factors**

Factor	RFD
Time Frame	2015–2035
Number of wells	16,000 (approximately 800 per year, federal and non-federal)
Average Water Use, Horizontal Well	7.3 AF (2.4 million gallons)
Average Water Use, Vertical Well	1.53 AF (500,000 gal)
Number of Wells Needed for Reservoir Development (play)	4 wells per section per play (horizontal wells)
Percentage of horizontal wells in Bone Spring Formation	84% horizontal
Percentage of horizontal wells in Leonard Formation	14% horizontal

As shown in the table above, the RFD concluded that the average water use for a single horizontal well was 7.3 AF. This figure was based on a study of the Bone Springs formation using data from 2013. Since that time, an estimate of 34.4 AF/horizontal well for the Permian Basin in 2016 was provided by Kondash et. al. (2018). The report concluded that “...the Permian Basin (Texas and New Mexico) had the largest increase in water use (770 percent), from 4900 m<sup>3</sup> per well (3.97 AF) in 2011 to 42500 m<sup>3</sup> per well (34.4 AF) in 2016” (Kondash et al. 2018). Because of this new information, BLM conducted studies using calendar year 2017 and 2018 data from FracFocus, 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. Operators are required by the State of New Mexico to disclose chemistry and water use information on FracFocus.

Reported water use in 2017 was 13,962 AF of which 21 percent (2,959 AF) was associated with federal wells (FracFocus 2017). Reported water use in 2018 was 21,742 AF of which 32 percent (6,936 AF) was



associated with federal wells (FracFocus 2018). These figures are higher than 2015 reported oil and gas water use (see Table 3-11) and corroborates that water use associated with hydraulic fracturing in the Permian Basin has been increasing in recent years. Analysis of the 2017 data set, consisting of 522 records, resulted an expected value of 26.9 AF, standard deviation of 17.47 AF, and a median of 24.78 AF. Analysis of the 2018 data set, consisting of 696 records, resulted in a mean of 31.2, standard deviation of 18.8 AF, and a median of 27.98 AF. As a result of these studies, the BLM considers the estimate of 31.2 AF as the best current estimate of water use per horizontal well in the Pecos District.

Note that if more water-intensive stimulation methods (e.g., slickwater fracturing) are implemented or if laterals become longer, water use could increase from this estimate). Alternatively, water use estimates could be lower if produced water is reused or recycled for use in hydraulic fracturing. Public concern about water use from hydraulic fracturing is especially high in semiarid regions, where water withdrawals for hydraulic fracturing can account for a significant portion of consumptive water use within a given region. The BLM will continue to evaluate reported water use in FracFocus and other data and will revise water use estimates to be used in NEPA evaluations accordingly.

### 3.3.2. *Impacts from the Proposed Action*

#### **Direct and Indirect Impacts**

Water use per horizontal well is estimated to be 31.2 AF/horizontal well for the Permian Basin. Vertical well water use is estimated to be 1.53 AF per well. See Table 3-12 for additional water use assumptions. The total water use for this action can be found by multiplying the number of wells in section 2.1 by 31.2 AF for horizontal well or 1.53 AF for vertical well.

#### **Cumulative Water Use Estimates**

##### Past and Present Actions

Pecos District total water usage (620,416 AF) accounted for about 19 percent of the total state withdrawals. Mining (which includes oil and gas development) comprises approximately 15 percent of Pecos District water withdrawals. Water use associated with oil and gas development (4,032 AF) comprises approximately 2.5 percent of the statewide Mining water use (163,901 AF), 4.3 percent of the Pecos District Tri-County Area Mining water use (94,758 AF), and 0.7 percent of Pecos District total water usage. The largest water use of water within the county and the state is agricultural, comprising 75% of all water use within the Pecos District and 82% percent of all water use within the state. This trend is expected to continue.

The BLM examined FracFocus to ascertain water use, cumulative water use, and water use trends in the New Mexico portion of the Permian Basin that is for Chaves, Eddy, and Lea counties-Table 3-13.

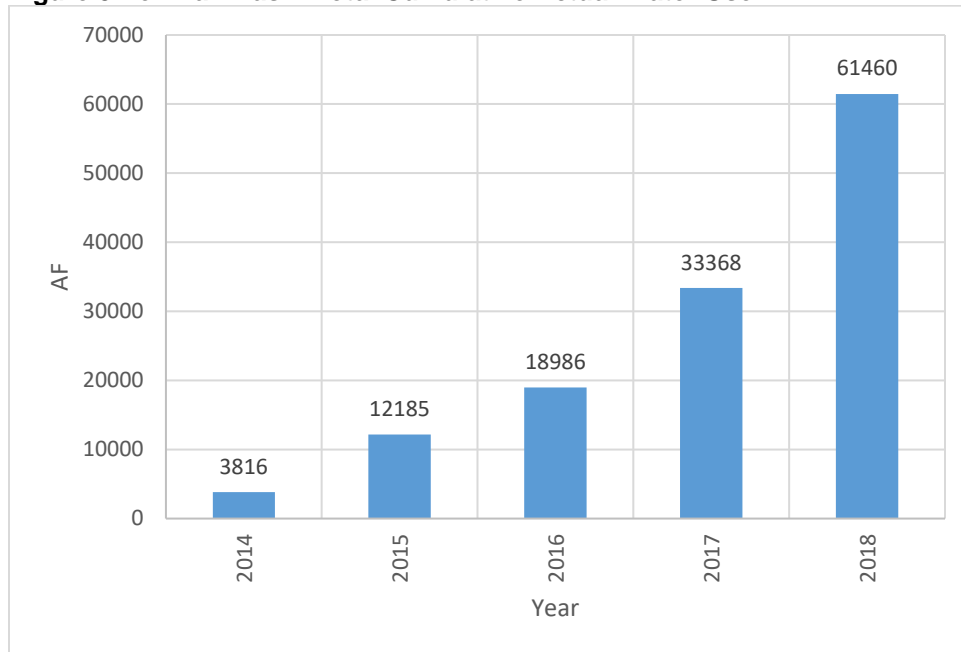
**Table 3-13 Actual Water Use in the NM portion of the Permian basin for Calendar Years 2014-2018**

<u>Year</u>	<u>Federal Water Use</u>	<u>Non-Federal Water Use</u>	<u>Total WU</u>	<u>%FedWU</u>	<u>FedCUMWU</u>	<u>TotCUMWU</u>	<u>Average WU/Well</u>	<u>Total # of Wells Reported to Frac Focus</u>
2014	1307	2509	3816	34.25	1307	3816	6.82	559
2015	4033	4336	8369	48.19	5340	12185	15.82	529
2016	710	6091	6801	10.44	6050	18986	21.66	314
2017	2964	11418	1482	20.61	9014	33368	26.44	544
2018	8411	19681	28092	29.94	17425	61460	31.04	905
	17425	44035	61460					2851

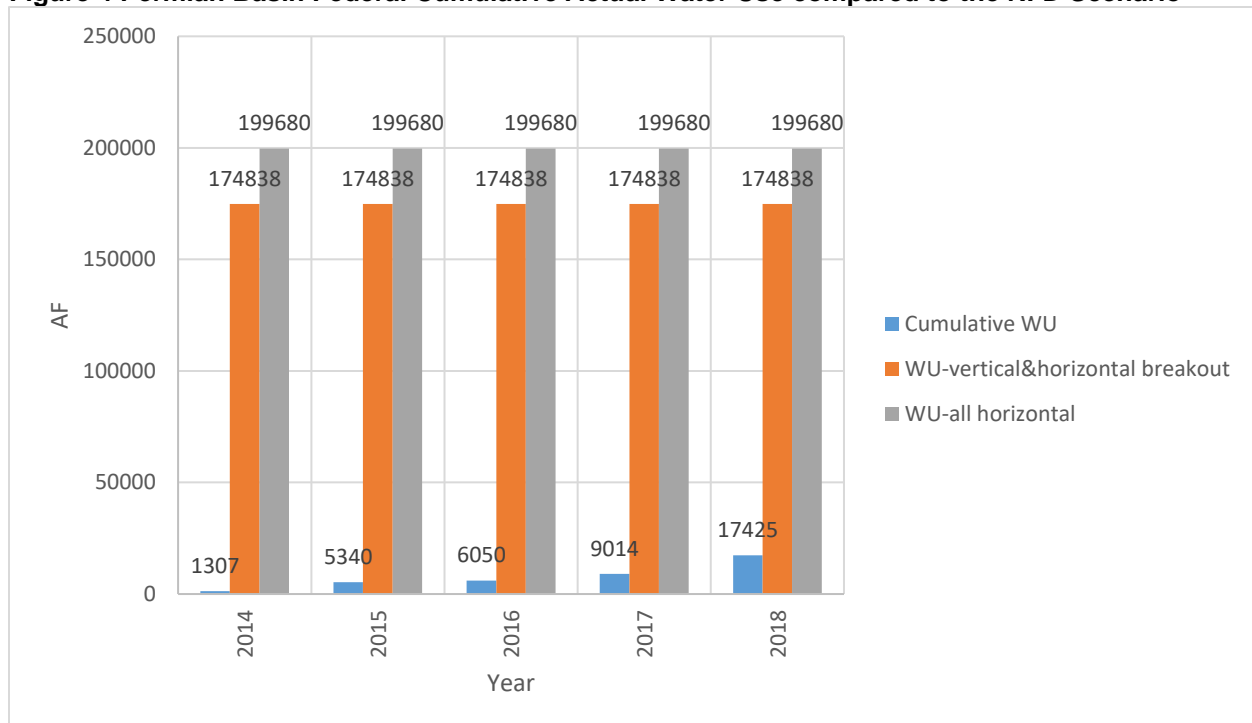
Figure 3 shows the total actual water use per year in the basin, it has increased from 6801 AF in 2016 to 28092 AF in 2018, with a corresponding basin-wide average water use per well increase from 22 AF/well to 31 AF/well (FracFocus, 2019). The Figure 5 shows the cumulative water use per year in the basin. A cumulative total of 61460 AF was used for oil and gas in HF for the years 2014-2018. Total federal cumulative water use in the basin, for the same time period was 17425 AF (Figure 4), a percentage of

28% of the total water use. The total number of wells that were reported to FracFocus, for 2016 to 2018, also increased from 314 to 905 wells.

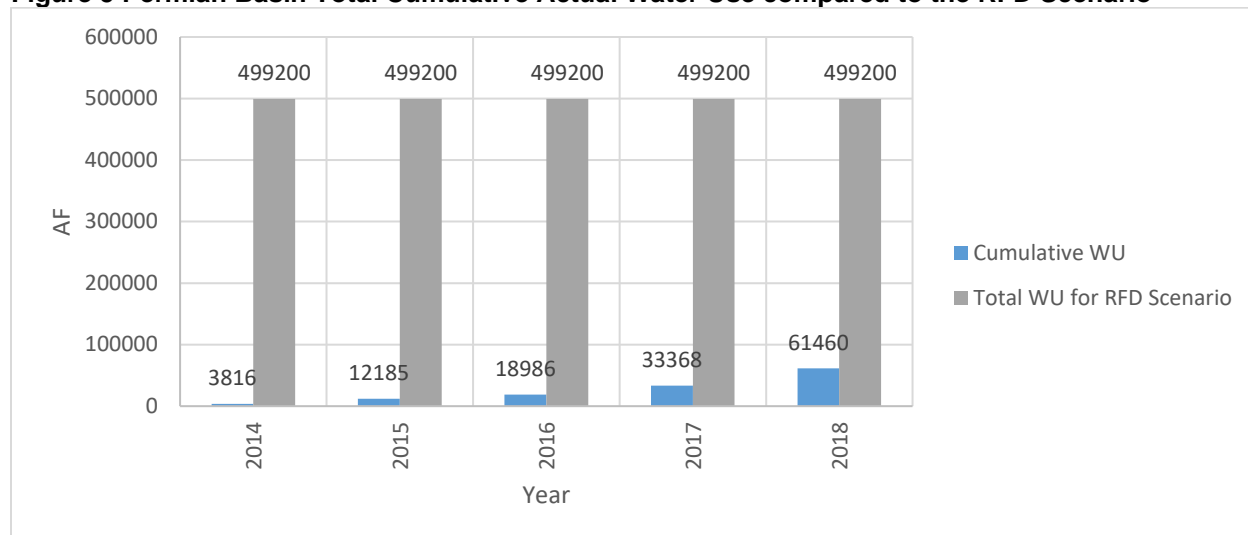
**Figure 3 Permian Basin Total Cumulative Actual Water Use**



**Figure 4 Permian Basin Federal Cumulative Actual Water Use compared to the RFD Scenario**



**Figure 5 Permian Basin Total Cumulative Actual Water Use compared to the RFD Scenario**



### ***Reasonably Foreseeable Future Actions (RFFAs)***

#### **Oil and Gas Development**

Between 2012 and 2014, the BLM prepared an RFD scenario for the Pecos District 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 presented above (31.2 AF per well), development of the 16,000 wells projected in the RFD would require 499,200 AF water, or 24,960 AF of water in any given year. Well development associated with recent or reasonably foreseeable APDs or master development plans are included in the RFD.

#### **Other Development**

There are no mining RFFAs that would contribute to cumulative water withdrawals within the Pecos District (BLM 2019b). Some water use would be required during construction and operation of reasonably foreseeable transmission lines and pipelines, these uses are minimal and are not quantified in this analysis. Future water use for the other reported water use categories in the Pecos District is assumed to continue at current levels.

### **Cumulative Impacts**

Development of all RFFAs would require 24,960 AF of water in any given year. This is about 4 percent of Pecos County 2015 total water withdrawals (620,416 AF, which already includes past and present actions). Agriculture would remain by far the largest water use within the county (currently 75% of all water use within the Pecos District and 82% percent of all water use within the state).

### **Potential Sources of Water for Project Development**

The Pecos District contains a variety of surface waters, from springs and seeps to lakes, playas, rivers, and ephemeral drainages and draws. Waters from spring developments, reservoirs or streams, and stream diversions within the planning area are used primarily for irrigation, livestock, and wildlife. No surface waters used for domestic purposes originate on BLM-managed land. Diversions on BLM-managed lands support private land crop irrigation and stock water needs. Water use associated with oil and gas drilling is primarily from groundwater. Table 3-14 shows the potential sources of groundwater in Pecos District. Figure 6 is an idealized cross section of these aquifers. It is speculative to predict the actual source of water that would be used for development of the RFD (or the development of any specific lease sales). However, because approximately 88 percent of all water use and 100 percent of all mineral use in the Pecos District is currently from groundwater, it is reasonable to assume that water used for development of the RFD would likely be groundwater. Water used for oil and gas drilling and completion would be purchased legally from those who hold water rights in or around the Permian Basin.

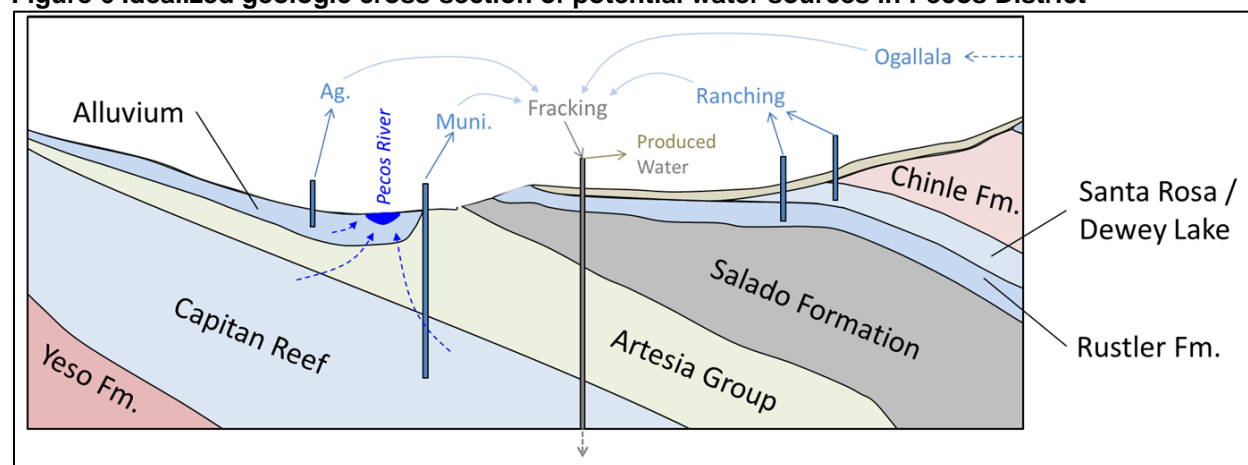
The transaction would be handled by the New Mexico Oil Conservation Division, as well as the New Mexico Office of the State Engineer.

**Table 3-14 Potential Sources of Groundwater in Pecos District**

Aquifer Name	Description
Pecos Valley Alluvium	Surficial deposits along the Pecos River. No known recharge areas.
Dewey Lake and Santa Rosa	Redbed sandstones. Inconsistent water source. Recharge occurs closer to the surface, as a result of weather events.
Rustler Formation (Culebra and Magenta)	Dolomite, fractured and dissolution zones. Local recharge occurs, largely as a result of weather events.
Capitan Reef	Limestone, Karstic formation. Good quality west of the Pecos, low quality towards the east. Recharge in the west occurs mainly in the vicinity of the Guadalupe Mountains. Recharge in the east occurs in the vicinity of the Glass Mountains (in Texas). The New Mexico portion of the eastern part of the Capitan Reef is recharging at a high rate
Ogallala	Sand and gravel. Offsite aquifer where water imported to area.

Source: Lowry et al 2018.

**Figure 6 Idealized geologic cross-section of potential water sources in Pecos District**



Source: Summers 1972.

A recent study conducted by Sandia National Laboratory (Lowry et al. 2018) was completed in portions of Eddy and Lea counties that were identified as having of high potential for oil and gas development in the RFD. The study was undertaken to establish a water-level and chemistry baseline and develop a modeling tool to aid the BLM in understanding the regional water supply dynamics under different management, policy, and growth scenarios and to pre-emptively identify risks to water sustainability. The following section summarizes key information in that report related to groundwater sources.

Four high potential areas (HPAs) were studied. The HPAs were associated with the Alto Platform, Bone Spring, and Delaware Mountain Group plays, and were limited the extent of each to development on federal lands managed by the BLM.

Most of the wells that were sampled in each HPA appeared to have a mix of source waters and establishing definitive signatures for each aquifer was not possible. However, evidence shows that the main water source for wells in the North HPA (which included Loco Hills and areas along the Pecos River) are from the Dewey Lake and Santa Rosa aquifer or another perched source in the host Dockum Formation. For the Center North HPA (which encompasses a region known as Burton Flats), the main sources are from the Dewey Lake and Santa Rosa aquifer and the Rustler Formation. For the South HPA (located near Malaga and Loving), the main water sources are the Dewey Lake and Santa Rosa aquifer. The east HPA, which primarily represents the Ogallala aquifer, was excluded from the study because only a small percentage of the land is managed by the BLM and because the aquifer is heavily pumped for agricultural purposes throughout several states, which would require a broader study of the overall aquifer (Lowry et al. 2018). The study also sampled wells that access water from the Capitan Reef, located near the community of Carlsbad.

Select wells were also monitored using both continuous and manual water level measurements throughout the study:

- Water levels in the two sampling water wells located in the North HPA fluctuated only slightly ( $>1$  pounds per square inch [psi]) and carried no obvious trend, indicating a high likelihood that the water level variations are naturally occurring through seasonal and barometric pressure fluctuations.
- Of the two monitoring wells located in the Center North HPA, one showed only show water level changes suggestive of barometric effects and seasonal change; the other well displayed a sharp water level increase. The cause of this change is conjectured to be from active drilling, pumping, or injecting near the well.
- Of the 16 wells monitoring the South HPA:
  - 2 wells showed minimal water level change with a slight increasing trend over time, indicating that the aquifer is not being locally impacted by pumping or aquifer development.
  - 2 wells showed pressure variations that are typical to nearby pumping. One well was located near a known oil supply well which is the likely driver to the drawdown and recovery response; the other was located near a municipal water supply well and its erratic response is indicative of pumping cycles associated with a small community water supply.
  - 5 wells displayed water level changes that are typical for aquifers affected by seasonal variations in pressure and barometric effects.
  - 3 wells showed minor water level changes likely due to activity in adjacent wells. The origin of the aquifer activity affecting each well are unknown, but likely due to oilfield drilling activities.
  - 1 well had drastic changes in water level as a result of nearby pumping tests conducted as part of monitoring of the Waste Isolation Pilot Plant.
  - 3 wells displayed water level changes due to high production pumping by a local ranch.
- Of the five wells monitoring the Capitan Reef, two wells recorded pressure decreases. The source of the pressure change is undetermined, however it is likely these wells are influenced by precipitation given their shallow depth and the karstic nature of the formation, as well as from localized municipal pumping by the City of Carlsbad. The remaining 3 wells recorded water levels increasing at a relatively constant rate. This suggests that the aquifer in the eastern part of the Capitan is experiencing recharge

A model is being developed as part of the Sandia Report to simulates water availability over a range of different future scenarios, including drilling activity and water demand relative to identify areas that are most vulnerable and to estimate the risk to water sustainability.

The model is still under development, but when completed, it will allow BLM to look at the balances between water demand and water availability to predict and track both risks to each aquifer as well as calculate well drawdown. The intent is to screen future water extraction that may be unsustainable. The Carlsbad FO will have the capacity to apply this model during future NEPA actions.

## Water Use Mitigation Measures

Overall, there have been calls to increase the use of alternative water sources such as brackish water or recycling produced water, minimizing the strain on local freshwater resources (Kondash et al. 2018). The BLM encourages the use of recycled water in hydraulic fracturing techniques but does not have the ability to require this as mitigation.

Moreover, 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 returns 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). Thus, the ability to recycle water may be more limited than previously reported. Note that water use calculations above do not assume the use of recycled water.

### 3.2.2 Affected Environment

#### Water Quality

##### Groundwater

As noted in Section 3.2.3, the BLM contracted with Sandia National Laboratory to prepare a report (Lowry et al. 2018) on water sustainability in Pecos District related to oil and gas development. The following section summarizes key information in the report related to groundwater quality.

Groundwater quality in Eddy and Lea Counties and in the Lower Pecos Valley varies considerably depending on the aquifer and location. In general, groundwater on the west side of the Pecos River is fresher than east of the Pecos River. East of the Pecos River, salinity is higher and can reach concentrations of 35,000 milligrams per Liter (mg/L). Shallow groundwater quality can be very good in the alluvial aquifers, but of poor quality in deeper geologic formations due to the presence of salt, gypsum, and other evaporite deposits. Groundwater tends to be mineralized or 'hard' west of the Ogallala aquifer (Lowry et al. 2018). Typical ranges of total dissolved solids (TDS) along with the general aquifer materials are shown in Table 3-15.

**Table 3-15 Typical TDS Ranges Found in the Main Aquifers of the Pecos District**

Aquifers	Aquifer Material	Typical TDS Range (mg/L)
Pecos	Alluvium	<200 to 10,000
Rustler (includes Culebra and Magenta)	Carbonates and Evaporites	<1,000 to 4,600
Dockum (includes Dewey Lake and Santa Rosa)	Sandstone and Conglomerates	<5,000 to >10,000
Capitan Reef	Dolomite and Limestone	300 to >5,000

Source: Lowry et al. 2018.

Overall 30 wells in the South HPA, 11 wells in the Center North HPA, and 19 wells in the North HPA were selected for water quality analysis. The predominant water types for each of the HPAs and the Capitan Reef are listed below

1. North – calcium and magnesium dominant
2. Center-North – sodium and calcium dominant
3. South – sodium and calcium dominant
4. Waste Isolation Pilot Plant (WIPP) – sodium and chloride dominant
5. Capitan Reef – sodium dominant

The samples were also compared to the New Mexico Water Quality Control Commission (NMWQCC) human health, domestic water supply, and irrigation use standards for groundwater with a TDS concentration of 10,000 mg/L or less (20.6.2.3103 NMAC). Table 3.16 presents a listing of the sampled water quality parameters by HPA against the NMWQCC standards for drinking water.

**Table 3-16 Sampled Water Quality Parameters Against NMWQCC Drinking Water Standards**

Parameter	NMWQCC Standard	North HPA	Central North HPA	South HPA and WIPP	Capitan Reef
pH (pH units)	6 to 9	7.07 - 7.97	7.53 - 7.97	6.18 - 8.59	8.08 - 8.86
Specific Conductance (µmhos/cm)	--	1000 - 3905	1300 - 83000	600 - 270000	2770 - 174500
Total Dissolved Solids (TDS)	1000	331 - 3550	869 - 43000	322 - 330000	1951 - 141875
Calcium (Ca <sup>2+</sup> )	--	0.73 - 590	2.6 - 920	0.7 - 1900	1.4 - 5902
Magnesium (Mg <sup>2+</sup> )	--	23 - 200	44 - 1492	2.10 - 10000	82.26 - 1420
Sodium (Na <sup>+</sup> )	--	18 - 262	92.58 - 12000	26 - 95000	225 - 46700
Potassium (K <sup>+</sup> )	--	0 - 30	4 - 1136	0 - 21000	6.58 - 3352
Chloride (Cl <sup>-</sup> )	250	16 - 1000	97 - 21000	11 - 190000	388.80 - 82602.1
Alkalinity (CaCO <sub>3</sub> )	--	139 - 312	19.9 - 181.2	23 - 297.10	18.53 - 250.10
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	--	139 - 312	19.8 - 181.2	39.72 - 297.10	18.74 - 249.27
Carbonate (CO <sub>3</sub> <sup>-</sup> )	--	0 - <2	0 - <2	0 - 16.08	0 - 0.83
Sulfate (SO <sub>4</sub> <sup>2-</sup> )	600	0 - 1900	306.71 - 6400	0 - 15000	0 - 1975.67
Fluoride (F <sup>-</sup> )	1.6	0 - 1.3	0.82 - 2.60	0.00 - 3.63	0.09 - 0.52
Nitrite (NO <sub>2</sub> )	10	0 - 6.27	0 - 8.8	0.00 - 20.08	0.05 - 7.60
Nitrate (NO <sub>3</sub> )	10	0 - 10	2.6 - 8.8	0 - 19	0.04 - 7.60
Silver (Ag)	0.05	--	--	--	0
Aluminum (Al)	5	--	0.18	0 - 4.06	--
Arsenic (As)	0.1	0.02 - 0.06	0.03 - 0.32	0 - 0.29	0.10
Barium (Ba)	1	0.01 - 0.13	0.01 - 0.03	0 - 0.1	0.02 - 0.25
Bromide (Br)	--	0 - 7.8	0.28 - 12.00	0 - 1400	0.3 - 12.73
Cadmium (Cd)	0.01	--	--	--	--
Copper (Cu)	1	0.02	0.03	0.06 - 0.37	--
Iron (Fe)	1	3.34	0.04	0.01 - 1.62	3.41
Lithium (Li)	--	0.14 - 1.70	0.140 - 1.695	0.05 - 0.85	0.04 - 4.49
Manganese (Mn)	0.2	0 - 0.06	0 - 0.20	0 - 0.06	0 - 7.61
Nickel (Ni)	0.2	--	0 - 0.02	0 - 0.01	0.01
Lead (Pb)	0.05	0.04	--	0.02 - 0.06	--
Silicon (Si)	--	2.67 - 18.38	1.9 - 23.4	4.91 - 47.0	0 - 7.10
Strontium (Sr <sup>2+</sup> )	--	0.63 - 8.47	2.73 - 13.75	0.05 - 32.0	2.52 - 104.8
Vanadium (V)	--	--	0.01 - 0.03	0 - 0.1	--

Source Lowry et al. 2018. Units are milligrams per liter (mg/L) unless otherwise noted. "--" = not applicable or not detected. Values rounded to two decimal places.



Key observations related to the comparison of results to the standards:

- Seventeen of the water quality parameters analyzed have applicable NMWQCC standards, including pH, TDS, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, F<sup>-</sup>, NO<sub>3</sub><sup>-</sup>+ NO<sub>2</sub><sup>-</sup>, Ag, Al, As, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Pb

No exceedances were observed for eight of the parameters with NMWQCC standards, including pH, Ag, Al, Ba, Cd, Cr, Cu, and Ni.

### **Surface Water**

Stream and river conditions vary widely, from completely undisturbed river and vegetative communities in the mountainous highlands, to deep, erodible soil banks at lower elevations where livestock, recreationists, and other public users have access to stream and riverbanks.

Water quality in streams flowing on BLM-managed land is influenced by both natural water quality with regard to salinity content and the intensity of human and industrial activity in the watershed. For example, water quality may be vastly different in a remote mountain spring creek than in waters with natural brine discharge, or where there are human impacts due to urban, farming, ranching, or industrial activity. Chemistry samples of surface water in the planning region are needed in order to establish a baseline chemistry data for the waters. Variances in baseline chemistry can indicate water quality changes attributable to land use development. The most common pollutants for waters in the planning area are sediment and mercury. Beneficial uses listed for these waters are industrial water supply, irrigation storage, livestock watering, recreation, warm water fishery, and wildlife habitat. The dominant legislation affecting national water quality and BLM compliance with New Mexico water quality requirements is the Clean Water Act (CWA) or Federal Water Pollution Control Act. Within the planning area, total maximum daily loads (TMDLs) determinations are not in place for any of the watersheds with 303(d)-listed streams. Thus, an assessment of their condition via this metric is not possible at the time.

---

### **3.3.3. Impacts from the Proposed Action**

#### **Potential Water Sources of Surface Water or Groundwater Contamination**

##### **Spills**

Spills associated with oil and gas development may reach surface water directly during the spill event. Spills may also reach surface waters indirectly, when the spill has occurred, and a rain event moves contaminants into nearby surface water bodies through surface water flow or even subsurface groundwater flow into springs that discharge into a surface water body.

There are approximately 15,660 federal wells within the New Mexico portion of the Permian Basin planning area (BLM 2019). As shown in Table 3-17, there were a total of 1,261 spills in the Permian Basin in 2018. The rate of recovery varies by spill type but in generally, most spills are not recovered. No spills occurring in the Pecos District were reported as having affected surface or groundwater.

The BLM works with the NMOCD to remediate spills on public BLM lands. 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 contaminants 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.

##### **Drilling and Completion Activities**

The BLM and State of New Mexico Oil Conservation Division (NMOCD) has casing, cementing, and inspection requirements in place to limit the potential for groundwater reservoirs and shallow aquifers to be impacted by fracking or the migration of hydrocarbons on the nominated lease parcels.

Prior to approving an APD, a BLM geologist would identify all potential subsurface formations that would be penetrated by the wellbore including groundwater aquifers and any zones that would present potential safety or health risks that would need special protection measures during drilling, or that could require specific protective well construction measures. Casing programs and cement specifications would be submitted to the BLM and NMOCD for approval to ensure that well construction design would be adequate to protect the subsurface environment, including known or anticipated zones with potential risks or zones identified by the geologist. Surface casing would be set to an approved depth, and the well casing and cementing would stabilize the wellbore and provide protection to any overlying freshwater aquifers by isolating hydrocarbon zones from overlying freshwater aquifers. Before hydraulic fracturing takes place, all surface casings and intermediate zones would be required to be cemented from the bottom of the cased hole to the surface. The cemented well would be pressure tested to ensure there are no leaks, and a cement bond log would be run to confirm that the cement has bonded to the steel casing strings and to the surrounding formations.

## Water Quality Mitigation Measures

### Spills

Secondary containment of production facilities as required on the Conditions of Approval. Best Management Practices for leak detection systems and berming to prevent spills from leaving the pad.

**Table 3-17 Summary of 2018 Spills in the New Mexico Portion of the Permian Basin**

Material Type	Count of Spills	Volume Spilled	Volume Lost	Units	% Lost
Acid	1	20	1	Barrels	5%
Basic sediment and water (BS&W)	5	19	9	Barrels	47%
Brine Water	3	1,570	1,531	Barrels	98%
Chemical	9	1,342	1,165	Barrels	87%
Condensate	13	405	258	Barrels	64%
Crude Oil	435	15,388	6,595	Barrels	43%
Diesel	3	24	16	Barrels	67%
Drilling Mud/Fluid	6	615	353	Barrels	57%
Other	26	15,049	14,060	Barrels	93%
Produced Water	606	90,931	44,775	Barrels	49%
Sulphuric Acid	1	20	15	Barrels	75%
<b>Total</b>	<b>1,108</b>	<b>125,383</b>	<b>68,778</b>	<b>Barrels</b>	<b>55%</b>
Natural Gas (Methane) and Natural Gas Liquids	153	144,813	144,813	MCF	100%
<b>Total Number of Spills</b>	<b>1,261</b>				

NMOCD 2019.

### Drilling and Completion Activities

The BLM requires operators to comply with the regulations at 43 Code of Federal Regulations (CFR) 3160. These regulations require oil and gas development to comply with directives in the Onshore Orders and the orders of the Authorized Officer. Onshore Order No. 2 and the regulations at 43 CFR 3162.3-3 provide regulatory requirements for hydraulic fracturing, including casing specifications, monitoring and recording, and management of recovered fluids. The State of New Mexico also has regulations for drilling, casing and cementing, completion, and plugging to protect freshwater zones (19.15.16 New Mexico

Administrative Code). Complying with the aforementioned regulations require producers and regulators to verify the integrity of casing and cement jobs.

Casing specifications are designed and submitted to the BLM together with an APD. The BLM petroleum engineer independently reviews the drilling plan, and based on site-specific geologic and hydrologic information, ensures that proper drilling, casing and cementing procedures are incorporated in the plan in order to protect usable groundwater. This isolates usable water zones from drilling, completion/hydraulic fracturing fluids, and fluids from other mineral bearing zones, including hydrocarbon bearing zones. Conditions of Approval (COAs) may be attached to the APD if necessary to ensure groundwater protection. Installation of the casing and cementing operations are witnessed by certified BLM Petroleum Engineering Technicians. At the end of the well's economic life, the operator must submit a plugging plan, which undergoes review by the BLM petroleum engineer prior to well plugging, which ensures permanent isolation of usable groundwater from hydrocarbon bearing zones. BLM inspectors ensure planned procedures are properly followed in the field.

Surface casing and cement would be extended beyond usable water zones. Production casing will be extended and adequately cemented within the surface casing to protect other mineral formations, in addition to usable water bearing zones. These requirements ensure 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. Since the advent of hydraulic fracturing, more than 1 million hydraulic fracturing treatments have been conducted, with perhaps only one documented case of direct groundwater pollution resulting from injection of hydraulic fracturing chemicals used for shale gas extraction (Gallegos and Varela 2015). Requirements of Onshore Order #2 (along with adherence to state regulations) make contamination of groundwater resources highly unlikely and there have not been any documented past instances of groundwater contamination attributed to well drilling. This is an indication of how effective the use of casing and cement is at preventing leaks and contamination.

### **3.4. Watershed**

#### **3.4.1. *Affected Environment***

The area of the proposed action drains in a southern direction into many unnamed drainages. The ground water recharge is from local precipitation entering through playas, sinkholes and swallets. Water quality and quantity is influenced by physical, chemical, and biological reactions that occur as water moves over and through the land surface toward streams and into aquifers. The rate at which water moves through the watershed strongly affects these reactions.

#### **3.4.2. *Impacts from the Proposed Action***

##### **Direct and Indirect Impacts**

Ephemeral surface water from local rain events will wash down-slope through the area of the proposed action. Localized decreases in vegetative surface cover combined with the caliche covering the pad and road could result in decreased infiltration rates and increased runoff volume and velocity. This causes increased erosion, topsoil loss, and sedimentation.

Water quality can be adversely affected following the occurrence of an undesirable event such as a leak or spill.

Standard practices or design features of the proposed project that minimize impacts to the watershed and water quality include: utilizing a closed loop system with no reserve pits, berming of the production facilities, utilizing existing surface disturbance, minimizing the well pad and access road total surface disturbance, minimizing vehicular use, surfacing parking and staging areas with caliche and reclaiming the areas not necessary for production and quickly reestablishing vegetation on the reclaimed areas.

## **Mitigation Measures and Residual Impacts**

The entire well pad(s) will be bermed to prevent oil, salt, and other chemical contaminants from leaving the well pad. The compacted berm shall be constructed at a minimum of 12 inches with impermeable mineral material (e.g. caliche). Topsoil shall not be used to construct the berm.

No water flow from the uphill side(s) of the pad shall be allowed to enter the well pad. The integrity of the berm shall be maintained around the surfaced pad throughout the life of the well and around the downsized pad after interim reclamation has been completed. Any water erosion that may occur due to the construction of the well pad during the life of the well will be quickly corrected and proper measures will be taken to prevent future erosion. Stockpiling of topsoil is required. The topsoil shall be stockpiled in an appropriate location to prevent loss of soil due to water or wind erosion and not used for berming or erosion control. If fluid collects within the bermed area, the fluid must be vacuumed into a safe container and disposed of properly at a state approved facility.

Tank battery locations will be lined and bermed. A 20-mil permanent liner will be installed with a 4 oz. felt backing to prevent tears or punctures. Tank battery berms must be large enough to contain 1 ½ times.

## **3.5. Karst Resources**

### **3.5.1. *Affected Environment***

The proposed project is located within a gypsum karst terrane – a landform characterized by underground drainage through solutionally enlarged conduits. Gypsum karst terranes may contain sinkholes, sinking streams, caves, and springs. These karst features, as well as occasional fissures and discontinuities in the bedrock, provide the primary sources for rapid recharge of the groundwater aquifers of the region.

The BLM categorizes all areas within the Carlsbad Field Office as having either low, medium, high or critical cave potential based on geology, occurrence of known caves, density of karst features, and potential impacts to freshwater aquifers. This project occurs within a medium karst zone. A medium karst zone is defined as an area that contains known soluble rocks within 300 feet of the surface with shallow insoluble overburden or soils that could mask surface features. These areas may contain isolated karst features such as caves and sinkholes. Groundwater recharge may not be wholly dependent on karst features but the karst features still provide the most rapid aquifer recharge in response to surface runoff.

Unknown features may also exist. Due to these factors, this action is subject to mitigation measures designed to adequately protect known and potential cave/karst resources.

Sinkholes and cave entrances collect water and can accumulate rich organic materials and soils. This, in conjunction with the stable microclimate near cave entrances, support a greater diversity and density of plant life which provides habitat for a greater diversity and density of wildlife such as raptors, rodents, mammals, and reptiles.

The interior of the caves support a large variety of troglobitic, or cave environment dependent, species. These species have adapted specifically to the cave environment due to constant temperatures, constant high humidity, and total darkness. Some caves may contain bat colonies. Many of the caves in this area contain fragile cave formations known as speleothems.

### **3.5.2. *Impacts from the Proposed Action***

#### **Direct and Indirect Impacts**

##### **General Impact Analysis**

Cave and karst features provide direct conduits leading to groundwater. These conduits can quickly transport surface and subsurface contaminants directly into underground water systems and freshwater aquifers without filtration or biodegradation.

In addition, contaminants spilled or leaked into or onto cave/karst zone surfaces and subsurface may lead directly to the disruption, displacement, or extermination of cave species and critical biological processes. In extreme and rare cases, a buildup of hydrocarbons in cave systems associated with surface leaks or spills could potentially cause underground ignitions or asphyxiation of wildlife or humans within the cave.

In cave and karst terranes, rainfall and surface runoff is directly channeled into natural underground water systems and aquifers. 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. Blasting, heavy vibrations, and focusing of surface drainages can lead to slow subsidence, sudden collapse of subsurface voids, and/or cave ecosystem damage.

A more complete discussion of the impacts of oil and gas drilling can be found in the *Dark Canyon Environmental Impact Statement of 1993*, published by the U.S. Department of the Interior, Bureau of Land Management.

To mitigate or lessen the probability of impacts associated with the drilling and production of oil and gas wells in karst areas, the guidelines listed in Appendix 3, Practices for Oil and Gas Drilling and Production in Cave and Karst Areas, as approved in the Carlsbad Resource Management Plan Amendment of 1997, page AP3-4 through AP 3-7 will be followed.

BLM maintains up to date locations and surveys of known cave and karst features. New surveys may be required for projects in areas where the BLM does not have sufficient information. Projects will be moved away from these features. Drilling pads, roads, utilities, pipelines, flowlines and other facilities or projects will be relocated or routed around cave and karst features at an adequate distance to mitigate adverse impacts. Wellbore engineering plans will incorporate required cave and aquifer protection protocols.

Highly sensitive cave and karst areas with critical freshwater aquifer recharge concerns may have a number of special surface and subsurface planning and construction requirements based upon the risk of adverse impacts created by a specific location or process.

### **Construction Impact Analysis**

The construction of roads, pipelines, well pads and utilities can impact bedrock integrity and reroute, impede, focus, or erode natural surface drainage systems. Increased silting and sedimentation from construction can plug downstream sinkholes, caves, springs, and other components of aquifer recharge systems and result in adverse impacts to aquifer quality and cave environments. Any contaminants released into the environment during or after construction can impact aquifers and cave systems. A possibility exists for slow subsidence or sudden surface collapse during construction operations due to collapse of underlying cave passages and voids. This would cause associated safety hazards to the operator and the potential for increased environmental impact. Subsidence processes can be triggered by blasting, intense vibrations, rerouting of surface drainages, focusing of surface drainage, and general surface disturbance.

Blasting fractures in bedrock can serve as direct conduits for transfer of contaminants into cave and groundwater systems. Blasting also creates an expanded volume of rock rubble that cannot be reclaimed to natural contours, soil condition, or native vegetative condition. As such, surface and subsurface disruptions from blasting procedures can lead to permanent changes in vegetation, rainfall percolation, silting/erosion factors, aquifer recharge, and freshwater quality and can increase the risk of contaminant migration from drilling/production facilities built atop the blast area.

### **Drilling Impact Analysis**

During drilling, previously unknown cave and karst features could be encountered. If a void is encountered while drilling and a loss of circulation occurs, lost drilling fluids can directly contaminate groundwater recharge areas, aquifers, and groundwater quality.

Drilling operations can also lead to sudden collapse of underground voids. Cementing operations may plug or alter groundwater flow, potentially reducing the water quantity at springs and water wells. Inadequate subsurface cementing, casing, and cave/aquifer protection measures can lead to the migration of oil, gas, drilling fluids, and produced saltwater into cave systems and freshwater aquifers.

### **Production Impact Analysis**

Production facilities such as tank batteries, pump-jacks, compressors, transfer stations, and pipe may fail and allow contaminants to enter caves and freshwater systems. Downhole casing and cementing failures can allow migration of fluids and/or gas between formations and aquifers. Facilities may also be subject to slow subsidence or sudden collapse of the underlying bedrock.

### **Residual and Cumulative Impact Analysis**

Any industrial activities that take place upon or within karst terranes or freshwater aquifer zones have the potential to create both short-term and long-term negative impacts to freshwater aquifers and cave systems. While a number of 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 mitigations measures are sufficient enough to prevent long-term or cumulative impacts.

### **Plugging and Abandonment Impact Analysis**

Failure of a plugged and abandoned well can lead to migration of contaminants to karst resources and fresh water aquifers. While this action does not specifically approve plugging and abandonment procedures, the operator should be made aware that additional or special Conditions of Approval may apply at that time.

## **Mitigation Measures**

### **Construction Mitigation**

In order to mitigate the impacts from construction activities on cave and karst resources, the following Conditions of Approval will apply to this APD or project:

#### **General Construction:**

- No blasting
- The BLM, Carlsbad Field Office, will be informed immediately if any subsurface drainage channels, cave passages, or voids are penetrated during construction, and no additional construction shall occur until clearance has been issued by the Authorized Officer.
- All linear surface disturbance activities will avoid sinkholes and other karst features to lessen the possibility of encountering near surface voids during construction, minimize changes to runoff, and prevent untimely leaks and spills from entering the karst drainage system.
- All spills or leaks will be reported to the BLM immediately for their immediate and proper treatment.

#### **Pad Construction:**

- The pad will be constructed and leveled by adding the necessary fill and caliche – no blasting.
- The entire perimeter of the well pad will be bermed to prevent oil, salt, and other chemical contaminants from leaving the well pad.
- The compacted berm shall be constructed at a minimum of 12 inches high with impermeable mineral material (e.g., caliche).
- No water flow from the uphill side(s) of the pad shall be allowed to enter the well pad.
- The topsoil stockpile shall be located outside the bermed well pad.
- Topsoil, either from the well pad or surrounding area, shall not be used to construct the berm.
- No storm drains, tubing or openings shall be placed in the berm.

- If fluid collects within the bermed area, the fluid must be vacuumed into a safe container and disposed of properly at a state approved facility.
- The integrity of the berm shall be maintained around the surfaced pad throughout the life of the well and around the downsized pad after interim reclamation has been completed.
- Any access road entering the well pad shall be constructed so that the integrity of the berm height surrounding the well pad is not compromised (i.e. an access road crossing the berm cannot be lower than the berm height).
- Following a rain event, all fluids will vacuumed off of the pad and hauled off-site and disposed at a proper disposal facility.

#### **Road Construction:**

- Turnout ditches and drainage leadoffs will not be constructed in such a manner as to alter the natural flow of water into or out of cave or karst features.
- Special restoration stipulations or realignment may be required if subsurface features are discovered during construction.

#### **Buried Pipeline/Cable Construction:**

- Rerouting of the buried line(s) may be required if a subsurface void is encountered during construction to minimize the potential subsidence/collapse of the feature(s) as well as the possibility of leaks/spills entering the karst drainage system.

#### **Powerline Construction:**

- Smaller powerlines will be routed around sinkholes and other karst features to avoid or lessen the possibility of encountering near surface voids and to minimize changes to runoff or possible leaks and spills from entering karst systems.
- Larger powerlines will adjust their pole spacing to avoid cave and karst features.
- Special restoration stipulations or realignment may be required if subsurface voids are encountered.

#### **Surface Flowlines Installation:**

- Flowlines will be routed around sinkholes and other karst features to minimize the possibility of leaks/spills from entering the karst drainage system.

#### **Drilling Mitigation**

Federal regulations and standard Conditions of Approval applied to all APDs require that adequate measures are taken to prevent contamination to the environment. Due to the extreme sensitivity of the cave and karst resources in this project area, the following additional Conditions of Approval will be added to this APD.

To prevent cave and karst resource contamination the following will be required:

- Closed loop system using steel tanks - all fluids and cuttings will be hauled off-site and disposed of properly at an authorized site
- Rotary drilling with fresh water where cave or karst features are expected to prevent contamination of freshwater aquifers.
- Directional drilling is only allowed at depths greater than 100 feet below the cave occurrence zone to prevent additional impacts resulting from directional drilling.
- Lost circulation zones will be logged and reported in the drilling report so BLM can assess the situation and work with the operator on corrective actions.
- Additional drilling, casing, and cementing procedures to protect cave zones and fresh water aquifers. See drilling COAs.

#### **Production Mitigation**

In order to mitigate the impacts from production activities and due to the nature of karst terrane, the following Conditions of Approval will apply to this APD:



- Tank battery locations and facilities will be bermed and lined with a 20 mil thick permanent liner that has a 4 oz. felt backing, or equivalent, to prevent tears or punctures. Tank battery berms must be large enough to contain 1 ½ times the content of the largest tank.
- Development and implementation of a leak detection system to provide an early alert to operators when a leak has occurred.
- Automatic shut off, check valves, or similar systems will be installed for pipelines and tanks to minimize the effects of catastrophic line failures used in production or drilling.

#### **Residual and Cumulative Mitigation**

The operator will perform annual pressure monitoring on all casing annuli and reported in a sundry notice. If the test results indicated a casing failure has occurred, remedial action will be taken to correct the problem to the BLM's approval.

#### **Plugging and Abandonment Mitigation**

Upon well abandonment in high cave karst areas additional plugging conditions of approval may be required. The BLM will assess the situation and work with the operator to ensure proper plugging of the wellbore.

### **3.6. Soils**

#### **3.6.1. *Affected Environment***

The area of the proposed action is mapped as UG-Upton gravelly loam 0-9% slopes. These are shallow soils and are described below:

##### Shallow

These soils are shallow to very shallow, well-drained, calcareous, stony and rocky loams over limestone and caliche. Topography ranges from nearly level ridgetops to side slopes to cliffs and escarpments. Permeability is moderate, water-holding capacity is very low to low, and runoff is rapid after the soils become saturated. They are subject to water erosion, but the stones and rock outcrops help to stabilize the soils on nearly level to gently sloping areas. Careful management is needed to maintain a cover of desirable forage plants and to control erosion. Reestablishing native plant cover could take 3-5 years due to unpredictable rainfall and high temperatures.

These soils typically have scattered populations of squamulose lichens and a few crustose lichens, while gelatinous lichens and cyanobacteria are occasionally present primarily in the pockets of deeper soils. These soil crusts are important in binding loose soil particles together to stabilize the soil surface and reduce erosion. Biological soil crusts can contribute positively to soil stability, fixing atmospheric nitrogen, nutrient contributions to plants, water infiltration, and plant growth. They function in the nutrient cycle by fixing atmospheric nitrogen, contributing to soil organic matter, and maintaining soil moisture. In addition, they can act as living mulch which discourages the establishment of annual/invasive weeds. Structurally they form an uneven, rough carpet that reduces rain drop impact and slows surface runoff. Below the surface, lichen and moss rhizines, fungal hyphae, and cyanobacterial filaments all act to bind the soil surface particles just below and at the surface. Horizontally, they occur in nutrient-poor areas between plant clumps. Because they lack a waxy epidermis, they tend to leak nutrients into the surrounding soil. Vascular plants such as grasses and forbs can then utilize these nutrients.

#### **3.6.2. *Impacts from the Proposed Action***

##### **Direct and Indirect Impacts**

There is a potential for wind and water erosion due to the erosive nature of these soils once the cover is lost. There is always the potential for soil contamination due to spills or leaks. The biological soil crusts are susceptible to compressional damage, which is due to vehicle traffic.

Disruption of the crust can result in decreased soil organism diversity, soil nutrient levels, soil stability, and organic matter. These impacts are expected to be limited to new oil and gas roads, pipeline right-of-ways and well pads. Soil contamination from spills or leaks can result in decreased soil fertility, less vegetative cover, and increased soil erosion.

Impacts to soil resources are reduced by standard practices such as utilizing existing surface disturbance, minimizing the well pad and access road total surface disturbance, utilizing steel tanks instead of reserve pits, minimizing vehicular use, placing parking and staging areas on caliche surfaced areas, reclaiming the areas not necessary for production and quickly establishing vegetation on the reclaimed areas.

### **Mitigation Measures and Residual Impacts**

Interim reclamation will be conducted on all disturbed areas not needed for active support of production operations, and if caliche is used as a surfacing material it will be removed at time of reclamation to mitigate impacts to soil resources.

Topsoil will be stockpiled to enhance reclamation.

## **3.7. Wildlife**

### **3.7.1. Affected Environment**

This project occurs in the Chihuahuan Desert habitat type. The Chihuahuan desert is one of the four most biologically rich and diverse desert ecoregions in North America. Numerous plant species live in this desert. The Chihuahuan Desert stretches from the southeastern corner of Arizona across southern New Mexico and west Texas to the Edwards Plateau in the United States. It runs deep into central Mexico, including parts of the states of Chihuahua, northwest Coahuila, northeast Durango and several others. This Desert is bounded by the Sierra Madre Occidental to the west and the Sierra Madre Oriental to the east, extending as far south as San Luis Potosi and to the isolated islands of the Chihuahuan vegetation in the Mexico states of Queretaro and Hidalgo. In New Mexico, Chaves and Eddy Counties, west of the Pecos River, consist largely or entirely of Chihuahuan Desert habitat type. The dominant plant species throughout the Chihuahuan desert is creosote bush. Depending on diverse factors such as type of soil, altitude, and degree of slope, creosote bush, can be found in association with other woody and grass species.

The Chihuahuan desert supports a large number of wide-ranging mammals, herpetofauna, and avian species. Mammals include but are not limited to: pronghorn antelope, mule deer, grey fox, collared peccary, bobcat, desert cottontail, black tailed jack rabbit, kangaroo rat, pocket mice, woodrats and deer mice. Herpetofauna include but are not limited to: Texas horned lizard, greater earless lizard, several species of spiny and whip tail lizards, and several species of venomous and non-venomous snakes. Avian species include but are not limited to the following: greater roadrunner, curve-billed thrasher, scaled quail, Scott's oriole, black-throated sparrow, phainopepla, Worthen's sparrow, and cactus wren. In addition, numerous raptors inhabit the desert and include the great horned owl, burrowing owl, Aplomado falcon, and red-tailed hawk.

### **Sensitive Species, Including Threatened and Endangered**

#### **Texas Hornshell mussel (*Popenaias popeii*)-Federally Endangered**

The U.S. Fish and Wildlife Service (USFWS) was petitioned to list the Texas Hornshell mussel (*Popenaias popeii*) as an endangered species under the authority of Endangered Species Act (ESA) in 1989. The USFWS ruled that listing of the Hornshell was warranted but precluded in 2001. The Hornshell was proposed for listing as an endangered species in 2016. On March 12, 2018 it was listed as an endangered species.

The Texas Hornshell mussel is a freshwater mussel with an elongate, subtrapazoidal shell that can reach a length of 108 mm. The shells are compressed and have greater width than height, with outer color variation ranging from olive green to dark brown.

Historically the Texas Hornshell mussel occurred in the Pecos-Rio Grande drainage. Due to an increase in salinity however, much of this habitat is no longer considered suitable. At the present time, this species is only found in four locations including, a 14 km stretch of the Black River in New Mexico, the Lower Rio Grande in Texas, the Devil's River in Texas, and the Delaware River in New Mexico. The mussel has a preferred substrate that includes small-grained materials such as sand, silt or clay and are often found occupying undercut riverbanks, ledges, crevices, travertine shelves and under large boulders. As filter-feeding organisms, they require clean, flowing water. This makes them susceptible to both point source and non-point source water pollution, and particularly, changes in salinity. Since they are very sensitive to pollution, they are good indicators of aquatic ecosystem health.

The mussel has a parasitic larval stage. These larvae, known as glochidia, will attach to a host species, (typically a fish) for a period of up to six weeks while they transform into juvenile mussels, at which point, they then fall off the host. Host fishes enable the Hornshell to achieve life cycle completion. In addition, they contribute the dispersal of genetics for the mussel. If movement of host species becomes restrictive due to the construction of dams and other barriers, the movement of the mussel will also become restricted resulting in detrimental mussel population numbers.

### **Candidate Conservation Agreement**

The Candidate Conservation Agreement (CCA) is a voluntary agreement designed to implement mitigation and conservation measures for the Texas Hornshell mussel in order to protect the species and its habitat. This agreement is a collaborative effort between Center of Excellence (CEHMM), Bureau of Land Management (BLM) and USFWS and facilitates cooperation between industry such as oil and gas developers, in addition to other stakeholders regarding the mussel as well as the other "Covered Species" that are included in the document. These other "Covered Species" include the Rio Grande River Cooter (*Pseudemys gorzugi*), the Gray Redhorse (*Moxostoma congestum*), the Blue Sucker (*Cycleptus elongates*) and the Pecos Springsnail (*Pyrgulopsis pecosensis*). The CCA was developed for federal lands while a separate agreement, the Candidate Conservation Agreement with Assurances (CCAA), was developed for state and private lands. There are four designated riparian management zones that categorize the "Covered Area" of the CCA. These zones are described below:

- Zone A: Occupied Habitat within the Black River and Delaware River.
- Zone B: The Black and Delaware Rivers (excluding Zone A in each), Blue Springs, and their associated USGS 100-year floodplain.
- Zone C: Ephemeral drainages to the Black and Delaware rivers, including Owl Draw.
- Zone D: The area within the CCA Boundary, not otherwise described in management zones A, B, or C.

---

## ***Impacts from the Proposed Action***

### **Direct and Indirect Impacts**

Impacts of the proposed action to wildlife in the localized area may include: possible mortality, habitat degradation and fragmentation, avoidance of habitat during construction and drilling activities and the potential loss of burrows and nests.

Standard mitigation measures and elements of the proposed action minimize these impacts to wildlife. These include: the NTL-RDO 93-1 (modification of open-vent exhaust stacks to prevent perching and entry from birds and bats), nets on open top production tanks, interim reclamation, closed loop systems, exhaust mufflers, berming collection facilities, minimizing cut and fill, road placement, and avoidance of wildlife waters, stick nests, drainages, playas and dunal features. These practices reduce mortality to wildlife and allow habitat to be available in the immediate surrounding area thus reducing stressors on

wildlife populations at a localized level. Impacts to local wildlife populations are therefore expected to be minimal.

A BLM Natural Resource Specialist has worked with the applicant to locate the project and associated infrastructure away from these habitat features in order to minimize impacts to localized wildlife populations.

### **Texas Hornshell mussel (*Popenaias popeii*)-Federally Endangered**

The proposed project area falls within the “covered zones” of the CCA. This project would have a may affect, not likely to adversely affect determination regarding the Texas Hornshell mussel (USFWS Consultation # 02ENNM00-2017-F-0871). This determination is based on the fact that this project is located at least one mile away from the river. In addition, the following mitigation measures will be implemented.

### **Mitigation Measures**

Oil and Gas Zone D - CCA Boundary requirements.

- Implement erosion control measures in accordance with the Reasonable and Prudent Practices for Stabilization (“RAPPS”)
- Comply with SPCC requirements in accordance with 40 CFR Part 112
- Comply with the United States Army Corp of Engineers (USACE) Nationwide 12 General Permit, where applicable
- Utilize technologies (like underground borings for pipelines), where feasible
- Educate personnel, agents, contractors, and subcontractors about the requirements of conservation measures, COAs, Stips and provide direction in accordance with the Permit.

## **3.8. Special Status Plant Species (SSPS)**

### **3.8.1. 3.6.1. Affected Environment**

BLM Reference Manual 6840 – Special Status Species Management (2008) directs BLM to conserve “BLM special status species and the ecosystems upon which they depend on BLM-administered lands” (6840.01). Unsurveyed potential habitats for SSPS were identified within and/or adjacent to the project area for the proposed action. The following special status plant species may be affected by the Proposed Action.

### **Scheer’s Beehive Cactus (*Coryphantha robustispina* ssp. *scheeri*)**

Within the CFO, there are approximately 404 documented Scheer's beehive cactus individuals within 82 documented occurrences, constituting 31.15 acres of documented occupied habitat across a 61 mile range. Scheer's beehive cactus is federally not considered, state Endangered, globally Apparently Secure (species) and Vulnerable (subspecies), and has a New Mexico Rare Plant Scorecard rating of Weakly Conserved. The nearest known occurrence is 0.35 miles (528 meters) from proposed project features.

### **Tharp’s Bluestar (*Amsonia tharpii*)**

Within the CFO, there are approximately 24,105 documented Tharp's blue-star individuals within 6 documented occurrences, constituting 439.56 acres of documented occupied habitat across a 64 mile range. Tharp's blue-star is federally Under Review, state Endangered, globally Critically Imperiled, and has a New Mexico Rare Plant Scorecard rating of Weakly Conserved.

### **SSPS Survey**

BLM and/or third-party field botanists conducted BLM CFO SSPS Surveys for Scheer’s beehive cactus and Tharp’s bluestar. Five Scheer’s beehive cactus individuals were detected during field surveys.

---

### **3.8.2. 3.6.2. Impacts from the Proposed Action**

#### **Direct and Indirect Effects**

The analysis extent is the CFO boundary, and the analysis area includes all surface, regardless of ownership/administration. The threshold for quantitative analysis is SSPS known occupied habitat and or greater than 0.1% potential habitat within the Impacts Area of proposed project features. The Impacts Area for proposed project features ranges from 100 to 200 meters from the edge of proposed disturbance, depending on the intensity, extent and duration of surface disturbance. Direct impacts could result from construction, operation, and/or maintenance related activities within and adjacent to proposed project features. These activities could immediately displace or acutely stress SSPS individuals and/or reduce or degrade available habitat for SSPS. Vegetation treatments, such as mowing and/or herbicide application to maintain openness within and around project feature bounds, could also affect SSPS individuals and/or their habitats. Potential indirect impacts to SSPS and the ecological processes that sustain them include, but are not limited 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 and/or fragmentation, and pollinator and dispersal agents' visitation behaviors. Preconstruction clearance surveys inventory SSPS within and adjacent to proposed actions, enabling site-specific conservation actions.

BLM special status plant surveys would be required for any subsequent actions tiered from this analysis when the Impact Areas of the proposed actions intersect SSPS potential habitat that has not been surveyed within three years prior to the notice of application for the proposed action. If occupied habitat is observed within the Impact Areas for the proposed action, the proposed action would avoid occupied habitat and mitigate anticipated impacts as determined appropriate for the conservation of the species by the Authorized Officer in coordination with a BLM biologist.

While the proposed project may contribute to declines in species abundance, habitat quality, and species occurrence connectivity, the proposed action is not expected to cause significant impacts to special status plant species, pollinators or ecosystem integrity on BLM land by virtue of best practices. A decision to authorize the Proposed Action would not contribute to a need to list sensitive plant species under the ESA.

#### **Mitigation Measures**

##### **Special Status Plant Species (SSPS) Habitat Stipulations:**

Prior to initiating project construction activities, a barricade in the form of temporary fencing for the protection of Scheer's beehive cactus observed individuals will be installed.

For the protection of the known SSPS occurrences, a third-party biomonitor will be required to monitor vehicle activity while project-related surface disturbing activities are being conducted.

Vehicles and equipment will be kept on existing roads and approved surfaces only and will avoid travel across undisturbed surfaces; workers will be instructed not to park off the roads or ROW in undisturbed areas. Alterations to project design and additions of project components will require SSPS surveys and re-analysis of impacts if those project elements intersect SSPS suitable habitat.

---

## **3.9. Vegetation**

### **3.9.1. Affected Environment**

#### **Shallow Soil Type Plant Communities**

Warm season, short and midgrasses make up most of the understory in the proposed project area. These include gramas, tridens, curlyleaf muhly, wolftail, dropseeds, threeawn, and green sprangletop. The shrub overstory consists primarily of sotol, agaves, cactus, catclaw, sacahuista, yucca, skunkbush,

piñon/juniper, and broom snakeweed. A large variety of forbs, including croton, bladderpod, buckwheat, and globemallow can be found, with large fluctuations from season to season based on rainfall.

---

### **3.9.2. *Impacts from the Proposed Action***

#### **Direct and Indirect Impacts**

Construction of the well pad, central tank battery, and associated infrastructure would remove about 12.99 acres of vegetation. This impact would last as long as the well is productive. However, interim reclamation, conducted within 6 months of the well being completed would reduce this area. When the well is plugged and abandoned, the rest of the pad would be reclaimed and potentially re-vegetate in 3-5 years, depending on timely rainfall. By using the proper seed mix number 1, good seed bed preparation, and proper seeding techniques, this impact would be short term (two or three growing seasons).

Very little vegetation would be removed when the surface pipelines are installed. Typical surface pipeline installation practices do not require blading or clearing the right-of-way corridor. Disturbance to vegetation would include compression of the vegetation caused by construction vehicles traveling along the right-of-way corridor. Vegetation should quickly return to the disturbed area without requiring the application of a seed mixture.

Impacts to vegetation are reduced by standard practices such as utilizing existing surface disturbance, minimizing the well pad and access road total surface disturbance, utilizing steel tanks instead of reserve pits, minimizing vehicular use, placing parking and staging areas on caliche surfaced areas, reclaiming the areas not necessary for production and quickly establishing vegetation on the reclaimed areas.

#### **Mitigation Measures**

Interim reclamation will be conducted on all disturbed areas not needed for active support of production operations, and if caliche is used as a surfacing material it will be removed at time of reclamation to enhance re-establishment of vegetation.

---

## **3.10. Noxious Weeds and Invasive Plants**

### **3.10.1. *Affected Environment***

There are four plant species within the CFO that are identified in the New Mexico Noxious Weed List Noxious Weed Management Act of 1998. These species are African rue, Malta starthistle, Russian olive, and salt cedar. African rue and Malta starthistle populations have been identified throughout the Carlsbad Field Office and mainly occur along the shoulders of highway, state and county roads, lease roads and well pads (especially abandoned well pads). The CFO has an active noxious weed monitoring and treatment program, and partners with county, state and federal agencies and industry to treat infested areas with chemical and monitor the counties for new infestations.

Currently there are no known populations of invasive, non-native species within the project vicinity.

---

### **3.10.2. *Impacts from the Proposed Action***

#### **Direct and Indirect Impacts**

Any surface disturbance can increase the possibility of establishment of new populations of invasive, non-native species. The construction of the proposed action may contribute to the establishment and spread of African rue and Malta starthistle. The main mechanism for seed dispersion would be by equipment and vehicles that were previously used and/or driven across noxious weed infested areas. Noxious weed seed could be carried to and from the project area by construction equipment and transport vehicles.

#### **Mitigation Measures**

The operator shall be held responsible if noxious weeds become established within the areas of operations. Weed control shall be required on the disturbed land where noxious weeds exist, which

includes the roads, pads, associated pipeline corridor, and adjacent land affected by the establishment of weeds due to this action. The operator shall consult with the Authorized Officer for acceptable weed control methods, which include following EPA and BLM requirements and policies.

## **3.11. Range**

### **3.11.1. *Affected Environment***

The proposed action is within the Rustler Breaks allotment 77037. This allotment is a yearlong cow-calf deferred rotation operation. Range improvement projects such as windmills, water delivery systems (pipelines, storage tanks, and water troughs), earthen reservoirs, fences, and brush control projects are located within the allotment, but not located near the project vicinity. In general, an average rating of the range land within this area is 6 acres per Animal Unit Month (AUM). In order to support one cow, for one year, about 72 acres are needed. This equals about nine cows per section.

### **3.11.2. *Impacts from the Proposed Action***

#### **Direct and Indirect Impacts**

The loss of 12.99 acres of vegetation would not affect the AUMs authorized for livestock use in this area. There are occasional livestock injuries or deaths due to accidents such as collisions with vehicles, falling into excavations, and ingesting plastic or other materials present at the work site. If the fence is damaged or a gate left open during construction of the proposed action, cattle may cross from one pasture or allotment to another. This will disrupt any grazing plan in place and could cause a loss in time and money to gather, sort, and return cattle to the correct pasture. If the pipeline is damaged or destroyed, livestock will not be able to drink. This can stress, or ultimately, kill the livestock. If further development occurs, the resulting loss of vegetation could reduce the AUMs authorized for livestock use in this area.

Impacts to the ranching operation are reduced by standard practices such as utilizing existing surface disturbance, minimizing the well pad and access road total surface disturbance, utilizing steel tanks instead of reserve pits, minimizing vehicular use, placing parking and staging areas on caliche surfaced areas, reclaiming the areas not necessary for production, and quickly establishing vegetation on the reclaimed areas.

#### **Mitigation Measures**

##### **Cattleguards**

Where a permanent cattleguard is approved, an appropriately sized cattleguard(s) sufficient to carry out the project shall be installed and maintained at fence crossing(s). Any existing cattleguard(s) on the access road shall be repaired or replaced if they are damaged or have deteriorated beyond practical use. The operator shall be responsible for the condition of the existing cattleguard(s) that are in place and are utilized during lease operations. A gate shall be constructed on one side of the cattleguard and fastened securely to H-braces.

##### **Fence Requirement**

Where entry granted across a fence line, the fence must be braced and tied off on both sides of the passageway prior to cutting. Once the work is completed, the fence will be restored to its prior condition, or better. The operator shall notify the private surface landowner or the grazing allotment holder prior to crossing any fence(s).

##### **Livestock Watering Requirement**

Structures that provide water to livestock, such as windmills, pipelines, drinking troughs, and earthen reservoirs, will be avoided by moving the proposed action.

Any damage to structures that provide water to livestock throughout the life of the well, caused by operations from the well site, must be immediately corrected by the operator. The operator must notify



the BLM office (575-234-5972) and the private surface landowner or the grazing allotment holder if any damage occurs to structures that provide water to livestock.

## **3.12. Visual Resource Management**

### **3.12.1. *Affected Environment***

The Visual Resource Management (VRM) program identifies visual values, establishes objectives in the RMP for managing those values, and provides a means to evaluate proposed projects to ensure that visual management objectives are met.

This proposed project occurs within a Visual Resource Management Class IV zone. The objective of VRM Class IV is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic landscape elements of color, form, line and texture.

### **3.12.2. *Impacts from the Proposed Action***

#### **Direct and Indirect Impacts**

This project will cause some short term and long-term visual impacts to the natural landscape. Short term impacts occur during construction operations and prior to interim reclamation. These include the presence of construction equipment vehicle traffic. However, interim reclamation, conducted within 6 months after construction will reduce this area by recontouring and revegetating.

Long term impacts are visible to the casual observer through the life of the well. These include the visual evidence of storage tanks, piping, pump jacks, pads and roads which cause visible contrast to form, line, color, and texture. Removal of vegetation due to construction exposes bare soil lighter in color and smoother in texture than the surrounding vegetation. The surfacing of these areas with caliche materials causes further contrasts. Those contrasts will be visible to visitors in the area.

After final abandonment and reclamation, the pad, road and associated surface infrastructure will be removed, reclaimed, recontoured and revegetated, thereby eliminating visual impacts.

Short and long term impacts are minimized by best management practices such as color selection, reducing cut and fill, screening facilities with natural features and vegetation, interim reclamation and contouring roads along natural changes in elevation.

#### **Mitigation Measures**

Above-ground structures including meter housing that are not subject to safety requirements are painted a flat non-reflective paint color, Shale Green from the BLM Standard Environmental Color Chart (CC-001: June 2008).

Short-term mitigation measures include painting all above-ground structures that are not subject to safety requirements (including meter housing) Shale Green, which is a flat non-reflective paint color listed in the BLM Standard Environmental Color Chart (CC-001: June 2013). Long-term mitigation measures include the removal of wells and associated infrastructure following abandonment (end of cost-effective production). Previously impacted areas will be reclaimed by removing structures and caliche pads, returning disturbed areas to natural grade, and revegetating with an approved BLM seed mixture; thereby eliminating visual impacts.

## 3.13. Special Designations

### 3.13.1. *Affected Environment*

The proposed action falls within an area that is a proposed as the Carlsbad Chihuahuan Desert Rivers Area of Critical Environmental Concern (ACEC), and will appear in at least one alternative in the CFO Resource Management Plan Revision (RMPR) Draft Environmental Impact Statement (DEIS). Carlsbad Chihuahuan Desert Rivers ACEC encompasses an area of approximately 103,833 BLM acres.

An ACEC is an area that is highlighted for special management attention to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish, or wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. ACEC nominations that meet the relevance and importance criteria are incorporated in appropriate RMP alternatives. Management is developed for each potential ACECs and it is included as a recommended ACEC in at least one RMP alternative.

For an area to be considered as a potential ACEC and analyzed in a resource management plan alternative, an area must meet the criteria, of relevance and importance (R&I), as established and defined in 43 CFR 1610.7-2, and BLM Manual 1613 (Areas of Critical Environmental Concern).

Carlsbad Chihuahuan Desert Rivers potential ACEC met the relevance and importance criterion for:

<b>Relevant and Important Criterion:</b>	<b>Importance Value met</b>
Historic, cultural, or scenic value	Has more than locally significant qualities which give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource.  Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
Fish and Wildlife Resources	Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
Natural Process or System	Has more than locally significant qualities which give it special worth, consequence, meaning, distinctiveness, or cause for concern, especially compared to any similar resource. Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change.
Natural hazards	Poses a significant threat to human life and safety or to property.

*Note: The R&I worksheets for each potential ACEC contain more information on how the area met or did not meet the R&I criterion and is available for review in the CFO Planning and Environmental department.*

The primary management objectives of the proposed Carlsbad Chihuahuan Desert Rivers ACEC are to protect the sites and areas of traditional cultural important to Native American tribes; sensitive cave and karst features; threatened vegetative species; and paleontological resources.

---

### 3.13.2. *Impacts from the Proposed Action*

#### **Direct and Indirect Impacts**

Direct and indirect impacts to a potential ACEC are assessed in the resource sections of this EA where an anticipated impact to the relevant and important value can be foreseen. For the Carlsbad Chihuahuan Desert Rivers ACEC, further discussion of impacts for R&I may be found in Wildlife Resources section 3.6, Soils Resources section 3.5, Cultural Resource section 3.13, Cave/Karst Resource 3.4, and Vegetation Resource section 3.8. Impacts to R&I values will only be discussed in those sections if an anticipated impact to the R&I value is expected to occur.

#### **Mitigation Measures and Residual Impacts**

Mitigation measures were developed to mitigate impacts to cave/karst resources. See wildlife resources section 3.6, cultural resource section 3.13, cave/karst resource 3.4, and vegetation resource section 3.8 above.

---

## 3.14. Cultural and Historical Resources

### 3.14.1. *Affected Environment*

The project falls within the Southeastern New Mexico Archaeological Region. This region contains the following cultural/temporal periods: Paleoindian (ca. 11,500 – 7,000 B.C.), Archaic (ca. 6,000 B.C. – A.D. 500), Ceramic (ca. A.D. 500 – 1400), Post Formative Native American (ca. A.D. 1400 – present), and Historic Euro-American (ca. A.D. 1865 to present). Sites representing any or all of these periods are known to occur within the region. A more complete discussion can be found in *Permian Basin Research Design 2016-2026 Volume I: Archaeology and Native American Cultural Resource published in 2016 by SWCA Environmental Consultants, Albuquerque, New Mexico.*

#### Native American Religious Concerns

The BLM conducts Native American consultation regarding Traditional Cultural Places (TCP) and Sacred Sites during land-use planning and its associated environmental impact review. In addition, during the oil & gas lease sale process, Native American consultation is conducted to identify TCPs and sacred sites whose management, preservation, or use would be incompatible with oil and gas or other land-use authorizations. With regard to Traditional Cultural Properties, the BLM has very little knowledge of tribal sacred or traditional use sites, and these sites may not be apparent to archaeologists performing surveys in advance of construction.

---

### 3.14.2. *Impacts from the Proposed Action*

#### **Direct and Indirect Impacts**

The project falls within the area covered by the Permian Basin Programmatic Agreement (PA). The Permian Basin PA is an optional method of compliance with Section 106 of the National Historic Preservation Act for energy related projects in a 39-quadrangle area of the Carlsbad Field Office. The PA is a form of off-site mitigation which allows industry to design projects to avoid known NRHP eligible cultural resources and to contribute to a mitigation fund in lieu of paying for additional archaeological inventory in this area that has received adequate previous survey. Funds received from the Permian Basin PA will be utilized to conduct archaeological research and outreach in Southeastern New Mexico. Research will include archaeological excavation of significant sites, predictive modeling, targeted research activities, as well as professional and public presentations on the results of the investigations.

The proponent plans to participate in the Permian Basin PA by planning to avoid all known NRHP eligible and potentially eligible cultural resources. The proponent has contributed funds commensurate to the undertaking into an account for offsite mitigation. Participation in the PA serves as mitigation for the effects of this project on cultural resources. If any human skeletal remains, funerary objects, sacred objects, or objects of cultural patrimony are discovered at any time during construction, all construction

activities shall halt and the BLM will be notified as soon as possible within 24 hours. Work shall not resume until a Notice to Proceed is issued by the BLM.

### **Mitigation Measures**

There are no mitigation measures for this project, as currently proposed.

## **3.15. Paleontology**

### **3.15.1. *Affected Environment***

Paleontological resources are any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth. Fossil remains may include bones, teeth, tracks, shells, leaves, imprints, and wood.

Paleontological resources include not only the actual fossils but also the geological deposits that contain them and are recognized as nonrenewable scientific resources protected by federal statutes and policies.

The primary federal legislation for the protection and conservation of paleontological resources occurring on federally administered lands are the Paleontological Resources Preservation Act of 2009 (PRPA), the Federal Land Policy and Management Act of 1976 (FLPMA), and the National Environmental Policy Act of 1970 (NEPA).

BLM has also developed policy guidelines for addressing potential impacts to paleontological resources (BLM, 1998a, b; 2008, 2009). In addition, paleontological resources on state trust lands are protected by state policy from unauthorized appropriation, damage, removal, or use.

The Potential Fossil Yield Classification (PFYC) is a tool that allows the BLM to predict the likelihood of a geologic unit to contain paleontological resources. The PFYC is based on a numeric system of 1-5, with PFYC 1 having little likelihood of containing paleontological resources, whereas a PFYC 5 value is a geologic unit that is known to contain abundant scientifically significant paleontological resources.

The fossil resources of concern in this area are the remains of vertebrates, which include species of fish, amphibians, and mammals.

### **3.15.2. *Impacts from the Proposed Action***

#### **Direct and Indirect Impacts**

Direct impacts would result in the immediate physical loss of scientifically significant fossils and their contextual data. Impacts indirectly associated with ground disturbance could subject fossils to damage or destruction from erosion, as well as creating improved access to the public and increased visibility, potentially resulting in unauthorized collection or vandalism. However, not all impacts of construction are detrimental to paleontology. Ground disturbance can reveal significant fossils that would otherwise remain buried and unavailable for scientific study. In this manner, ground disturbance can result in beneficial impacts. Such fossils can be collected properly and curated into the museum collection of a qualified repository making them available for scientific study and education.

The location of the proposed project is within a PFYC 2, where management concern is negligible. A pedestrian survey for paleontological resources was not necessary and there should be no impacts to paleontological resources.

### **Mitigation Measures**

There are no mitigation measures for this project, as currently proposed.

### 3.16. Cumulative Impacts

Cumulative impacts are the combined effect of past projects, specific planned projects, and other reasonably foreseeable future actions within the project study area to which oil and gas exploration and development may add incremental impacts. This includes all actions, not just oil and gas actions that may occur in the area including foreseeable non-federal actions.

The combination of all land use practices across a landscape has the potential to change the visual character, disrupt natural water flow and infiltration, disturb cultural sites, cause increases in greenhouse gas emissions, fragment wildlife habitat and contaminate groundwater. Cumulative impacts analysis to air quality, GHG emissions, water use, and quality is included in Chapter 3, under sections 3.1 and 3.2. The likelihood of these impacts occurring is minimized through standard mitigation measures, special Conditions of Approval and ongoing monitoring studies.

All resources are expected to sustain some level of cumulative impacts over time, however these impacts fluctuate with the gradual abandonment and reclamation of wells. As new wells are being drilled, there are others being abandoned and reclaimed. As the oil field plays out, the cumulative impacts will lessen as more areas are reclaimed and less are developed.

## 4. SUPPORTING INFORMATION

### 4.1. List of Preparers

Prepared by: Project Lead Zane Kirsch, Natural Resource Specialist, BLM-CFO

Date: 09/10/2021

The following individuals aided in the preparation of this document:

Aaron Whaley, Archaeologist, BLM-CFO  
Cassandra Brooks, Wildlife Biologist, BLM-CFO  
Kelsey Davis, Rangeland Management Specialist, BLM-CFO  
Amanda Eavenson, Hydrologist, BLM-CFO  
Ellen Trautner, Cave Specialist, BLM-CFO  
Tracey Hughes, Outdoor Recreation Planner/Cave Specialist, BLM-CFO  
Hector Gonzalez, Planning & Environmental Coordinator, BLM-CFO  
Catherine Brewster, Planning & Environmental Coordinator, BLM-NMSO  
Benjamin Gaddis, Natural Resource Specialist, BLM-NMSO  
Rebecca Hunt, Natural Resource Specialist, BLM-NMSO  
Sharay Dixon, Air Resource Specialist, BLM-NMSO  
David Herrell, Hydrologist, BLM-NMSO

### 4.2. References

Applied Enviro Solutions (AES). 2011. Southeast New Mexico Inventory of Air Pollutant Emissions and Cumulative Air Impact Analysis 2007. BLM. Carlsbad Field Office.

Bohannon, Paul 2009. The RCRA Exploration & Production Exemption.  
<http://bohannonlegal.com/pauls-oil-gas-manual-the-rcra-ep-exemption/>

Bureau of Land Management (BLM). 2005. BLM Handbook H-1601-1. Available at:  
[https://www.blm.gov/sites/blm.gov/files/uploads/Media\\_Library\\_BLM\\_Policy\\_Handbook\\_h1601-1.pdf](https://www.blm.gov/sites/blm.gov/files/uploads/Media_Library_BLM_Policy_Handbook_h1601-1.pdf). Accessed December 2019.

Bureau of Land Management (BLM). 2018. Air Resources Technical Report for Oil and Gas Development, New Mexico, Oklahoma, Texas and Kansas.

- Bureau of Land Management (BLM). 2018a. BLM Handbook H-1624-1 – Planning for Fluid Mineral Resources. Available at: <https://www.blm.gov/sites/blm.gov/files/H-1624-1%20rel%201-1791.pdf>. Accessed December 2019.
- Bureau of Land Management (BLM). 2019. *Cumulative BLM New Mexico Greenhouse Gas Emissions, A Supplemental White Paper*.
- Bureau of Land Management (BLM). 2019. Personal communication between David Herrell, BLM and Julie Valdez, NMOSE regarding water use associated with the Navajo Power Plant.
- Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S., 2018, Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441, 65 p. Report and dataset available at: <https://pubs.er.usgs.gov/publication/cir1441>. Downloaded April 1. 2019.
- Engler, T. 2013. Response to comments on the DEIS for the Ocho Mine Project. Socorro, NM, USA. November 16.
- Engler, T.W., and M. Cather. 2012. Reasonable Foreseeable Development (RFD) Scenario for the BLM. New Mexico Pecos District. Final Report. New Mexico Institute of Mining and Technology. Available at: [https://eplanning.blm.gov/epl-front-office/projects/lup/64444/77502/86228/Final\\_Report-BLM-NMT-RFD.pdf](https://eplanning.blm.gov/epl-front-office/projects/lup/64444/77502/86228/Final_Report-BLM-NMT-RFD.pdf). January 2019.
- Environmental Protection Agency. 2013. The Green Book Non Attainment Areas for Criteria Pollutants. <http://www.epa.gov/airquality/greenbk/> (Accessed 3/15/2013).
- Environmental Protection Agency. 2013. 2005 National-Scale Air Toxics Assessment. Summary of Results. <http://www.epa.gov/ttn/atw/nata2005>.
- Environmental Protection Agency. 2013. Air Trends: Design Values. <http://www.epa.gov/airtrends/values.html>.
- Environmental Protection Agency. 2018. *National Ambient Air Quality Standards (NAAQS)*. Retrieved from U.S. Environmental Protection Agency: <https://www.epa.gov/criteria-air-pollutants/naaqs-table>
- Fletcher, S. M. 2012. Risk Assessment of Groundwater Contamination from Hydraulic Fracturing Fluid Spills in Pennsylvania. Thesis (S.M. in Technology and Policy)--Massachusetts Institute of Technology, Engineering Systems Division, Technology and Policy Program. <http://hdl.handle.net/1721.1/72885>.
- Fitzgerald LA, Painter CW, Sias DS, Snell HL (1997) The range, distribution, and habitat of *Sceloporus arenicolus* in New Mexico: final report submitted to the New Mexico Department of Game and Fish (Contract #80-516.6-01).
- FracFocus. 2017.. Retrieved from FracFocus Data Download. Dataset available for download at the following: <http://fracfocus.org/data-download>. Downloaded December 13, 2018.
- FracFocus. 2018.. Retrieved from FracFocus Data Download. Dataset available for download at the following: <http://fracfocus.org/data-download>. Downloaded January 28, 2019.
- Gallegos, T.J., and Varela, B.A. 2015. Trends in hydraulic fracturing distributions and treatment fluids, additives, proppants, and water volumes applied to wells drilled in the United States from 1947 through 2010—Data analysis and comparison to the literature: U.S. Geological Survey Scientific Investigations Report 2014–5131, 15 p., <http://dx.doi.org/10.3133/sir20145131>. Accessed February 2019.

- Groundwater Protection Council (GWPC). 2009. Modern Shale Gas Development in the United States: A Primer. Prepared for the U.S. Department of Energy, Office of Fossil Energy, and National Energy Technology Laboratory (NETL). DE-FG26-04NT15455. Oklahoma City, OK. [http://www.netl.doe.gov/technologies/oilgas/publications/epreports/shale\\_gas\\_primer\\_2009.pdf](http://www.netl.doe.gov/technologies/oilgas/publications/epreports/shale_gas_primer_2009.pdf).
- Mire, K., and Moomaw, J. (2017) Delaware Basin: Seven Year Review of Activity and Performance. Unconventional Resources Technology Conference, Austin, Texas, pp 24-26. Available at: [https://library.seg.org/doi/abs/10.15530/urtec-2017-2697549#.XRYtE\\_cvHC0.email](https://library.seg.org/doi/abs/10.15530/urtec-2017-2697549#.XRYtE_cvHC0.email)
- NOAA. 2011. NOAA's 1981-2010 Climate Normals. National Climatic Center. <http://www.ncdc.noaa.gov/oa/climate/normal/usnormals.html>. (Accessed July 1, 2011).
- Railey, J. A. 2016  
*Permian Basin Research Design 2016-2026 Volume I: Archaeology and Native American Cultural Resources*. SWCA Environmental Consultants, Albuquerque, New Mexico.
- SENM. 2014. Update to the Reasonable Foreseeable Development (RFD) for the BLM Pecos District, SENM. Final Report. New Mexico Institute of Mining and Technology. Available at: [https://eplanning.blm.gov/epl-front-office/projects/lup/64444/80056/93025/Final\\_Report-SENM-DEC2014\\_updated\\_RFD.pdf](https://eplanning.blm.gov/epl-front-office/projects/lup/64444/80056/93025/Final_Report-SENM-DEC2014_updated_RFD.pdf)
- USDI. BLM. 2013. Air Resources Technical Report for Oil and Gas Development in New Mexico, Kansas, Oklahoma, and Texas. New Mexico State Office.
- Wenzel, C. 2012. A Case Study—Hydraulic Fracturing Geography: The Case of the Eagle Ford Shale, TX, USA. Thesis (M.S.)--Texas State University-San Marcos, Department of Geography. <https://digital.library.txstate.edu/handle/10877/4247>.



# Appendices

## Appendix A. Emissions Estimates for Oil and Gas Wells

Emissions for a one-well horizontal and oil gas well on federal lands are included in Tables 4-1 and 4-2. Emissions for vertical wells were omitted from this analysis due to current predominant technological drilling methods being horizontal. Additionally, presenting horizontal oil and gas wells emissions estimates represent a more conservative summary of emissions when compared to emissions from a vertical well with the exception SO<sub>2</sub> which could be 4-5x greater in a vertical well scenario however sulfur dioxide emissions are still estimated to be within the same magnitude and less <1 ton per year of SO<sub>2</sub> emissions per well.

**Table A-1 Emission Estimates for One Horizontal Oil Well**

Activity/ Phase	Annual Emissions (Tons)*							
	PM <sub>10</sub> <sup>†</sup>	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	VOC**	HAPs	CO <sub>2e</sub>
Construction	2.41	0.49	5.21	0.11	1.44	0.42	0.42	578.89
Operations	2.90	0.33	0.80	0.00	1.11	0.75	0.75	126.81
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.089
Reclamation**	0.00	0.00	0.18	0.00	0.08	0.00	0.00	0.00
<b>Total</b>	<b>5.31</b>	<b>0.81</b>	<b>6.19</b>	<b>0.11</b>	<b>2.63</b>	<b>1.17</b>	<b>1.17</b>	<b>705.79</b>

\* Values where a "0.00" appear may be too small and not appear due to rounding.

† Reclamation PM<sub>10</sub> emissions were estimated to be twice the value of Maintenance PM<sub>10</sub> values.

\*\*VOC emissions at the operational phase represent a 95% control efficiency and estimates potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc.

**Table A-2 Emission Estimates for One Horizontal Gas Well**

Activity/Phase	Annual Emissions (Tons)*							
	PM <sub>10</sub> <sup>†</sup>	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	CO	VOC	HAPs	CO <sub>2e</sub>
Construction	0.64	0.31	5.18	0.11	1.41	0.61	0.41	1125.79
Operations	0.28	0.18	0.34	0.00	0.46	0.16	0.18	126.81
Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.089
Reclamation <sup>†</sup>	0.00	0.00	0.18	0.00	0.08	0.00	0.00	0.00
<b>Total</b>	<b>0.92</b>	<b>0.49</b>	<b>5.71</b>	<b>0.11</b>	<b>1.95</b>	<b>0.77</b>	<b>0.59</b>	<b>1252.69</b>

\* Values where a "0.00" appear may be too small and not appear due to rounding.

† Reclamation PM<sub>10</sub> emissions were estimated to be twice the value of Maintenance PM<sub>10</sub> values.

Emission estimates for a construction, operations, maintenance and reclamation are included. Construction emissions for both an oil and gas well include well pad construction (fugitive dust), heavy equipment combustive emissions, commuting vehicles and wind erosion. Operations emissions for an oil well 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. Operations emissions for a gas well include well workover operations (exhaust and fugitive dust), wellhead and compressor station fugitives, well site visits for inspection and repair, recompletions, compression, 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, blade and track hoe equipment.