BLM

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

Environmental Assessment

OXY SMU 1–3–M and 6–4–I APDs

April, 2015

PREPARING OFFICE

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Bureau of Land Management
Royal Gorge Field Office
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Environmental Assessment
OXY SMU 1–3–M and 6–4–I APDs

DOI-BLM-CO-F02-2015-0036 EA

Prepared by
U.S. Department of the Interior
Bureau of Land Management
Royal Gorge Field Office
Canon City, CO

April, 2015

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Chapter 1 Introduction

1.1. Identifying Information:

1.1.1. Title, EA number, and type of project:

OXY SMU 1–3–M and 6–4–1 APDs

DOI-BLM-CO-F02-2015-036 EA

1.1.2. Location of Proposed Action:

27S 70W S9

1.1.3. Name and Location of Preparing Office:

Royal Gorge Field Office

1.1.4. Identify the Subject Function Code, Lease, Serial, or Case File Number:

COC 04399 and COC 10646

1.1.5. Applicant Name:

OXY USA

1.2. Introduction and Background

The BLM has received two Applications for Permits to Drill (APDs) for new Carbon Dioxide (CO_2) wells. The proposed SMU 1–3–M and SMU 6–4–I would be drilled from an extension of an existing location (Drill Site 1) which currently contains 6 producing CO_2 wells, compressor station, produced water tank, cooler and produced water tank. This pad would have to be expanded to accommodate the drilling equipment and the well heads. Most of the disturbance would be short term and remain disturbed during the drilling and completion stage. The Drill site 1 location has is on privately owned surface, and has been in place since the early 1980's. The project is within the Sheep Mountain Unit (SMU). There are several other active CO_2 wells and extensive existing infrastructure within the unit. The proposed wells are targeting BLM mineral estate and fee mineral estate. The federal minerals are leased and subject to development.

The CO_2 that is produced in the SMU is piped to the Permian Basin, where it is used for CO_2 flooding of oil wells.

The project is in Huerfano County, approximately 6 miles south of Gardner. The general area description would be defined as mountainous forest (mixed conifer and pinion/juniper) and rangeland on the northwest side of Sheep Mountain. The proposed project is located on a ranch used for cattle grazing and CO_2 production.

There was a pre-project onsite meeting attended by representatives from BLM RGFO and the operator on November 11, 2014. The surface owner was invited, by BLM and OXY, but did not attend. Access to the proposed project is limited to private roads constructed and maintained by the operator of SMU, over private surface. The only nearby structures are facilities related to the production of CO_2 in the SMU. There is no public access to the project area.

1.3. Purpose and Need

The purpose of the action is to provide the applicant the opportunity to develop their fluid mineral leases for the production of CO_2. Production will specifically target CO_2 reserves found underlying the Dakota and Entrada formations in this area. The need for the action is to develop CO_2 resources on Federal Lease COC04399 and COC10646 consistent with existing Federal lease rights provided for in the Mineral Leasing Act of 1920, as amended, and consistent with the fluid minerals provision in the RGFO RMP, and Federal Oil and Gas onshore orders.

1.4. Decision to be Made

The BLM will decide whether to approve the SMU 1–3–M and SMU 6–4–I Applications for Permits to Drill (APDs) project based on the analysis contained in this Environmental Assessment (EA). This EA will analyze the proposed action; to expand one existing location (pad), and drill two directional wells in order to develop federal and private minerals from a private surface. Access to the proposed project would be on existing highway, county and oil field roads. The finding associated with this EA may not constitute the final approval for the proposed action.

1.5. Plan Conformance Review

PLAN CONFORMANCE REVIEW: The Proposed Action is subject to and has been reviewed for conformance with the following plan (43 CFR 1610.5, BLM 1617.3):

> Name of Plan: Royal Gorge Resource Area Plan and Record of Decision
>
> Date Approved: 05/13/1996
>
> Decision Numbers: 10-27, 10-28, 10-29, 10-30.
>
> Decision Language: "BLM administered mineral estate will be open to fluid minerals leasing, exploration, and production subject to the lease terms and applicable lease stipulations as shown in Appendix A of this ARMP/ROD."

1.6. Scoping, Public Involvement and Issues

NEPA regulations (40 CFR §1500-1508) require that the BLM use a scoping process to identify potential significant issues in preparation for impact analysis. The principal goals of scoping are to allow public participation to identify issues, concerns, and potential impacts that require detailed analysis.

Persons/Public/Agencies Consulted: A two week public scoping period began on February 24th, initiated with a press release sent to media outlets on the RGFO's scoping list, and an e-mail was

sent to Huerfano County's local government designee for Oil and Gas. A project description was posted on the RGFO's website.

Issues Identified: One comment was received via E-mail expressing concerns about air and water quality. These issues were analyzed in the EA..

Chapter 2 Proposed Action and Alternatives

2.1. Description of the Proposed Action

The BLM RGFO has received two Applications for Permit to Drill (APDs), proposing the extension of an existing well pad, in order to drill two directional C02 wells on private surface over federal minerals to access federal and some private minerals.

2.2. Alternatives Analyzed in Detail

Although drilling and completion of these activities will take place on an existing pad, the pad must be expanded in order to accommodate the drilling rig and related equipment. This pad is located on private surface over federal minerals. The temporary footprint needed for drilling the well is approximately 8 acres. After interim reclamation, this surface disturbance will be reduced to just under 3 acres.

Due to the relatively steep terrain in the project area, a significant amount of dirt work is required. The drilling pad for the proposed 7-15-I will require a maximum cut of approximately 40 feet and a maximum fill of approximately 25 feet. This will result 200 cu yards of excess cut, and 4,800 cu yards of salvaged topsoil. The spoils will be segregated from the topsoil, which will be stripped from the location before construction begins. The stockpiles will be placed where they can be retrieved and redistributed over the project area for interim reclamation.

All access roads, pipelines, power lines, compressors and other necessary infrastructure are already in place and servicing the existing wells. If the well is a producer, only a short run of flowline from the wellhead to the existing compressor station on drill site 1 will be installed, entirely within the disturbed footprint of the drillpad.

Oxy estimates that approximately 9,000 barrels of water will be required to drill and complete each well for a total of approximately 18,000 barrels of water required for the project. There are multiple sources of water available for purchase for the drilling and completion of the wells. A spring owned by the surface owner, located in NE, NE of S 22, 27S 70W, is approved for drilling water supply, and will be the primary source of water for the project. Weber drilling is a commercial water transport and supply service who could provide additional water, as well as the Huerfano River, which Oxy has secured approval for drilling use for this project. Oxy has reached an agreement with the Huerfano County Water Conservancy District, and is covered under their Substitute Water Supply plan for the use of the spring and river sources. Water will be stored in portable, temporary tanks to reduce truck traffic and allow for the reuse of the water.

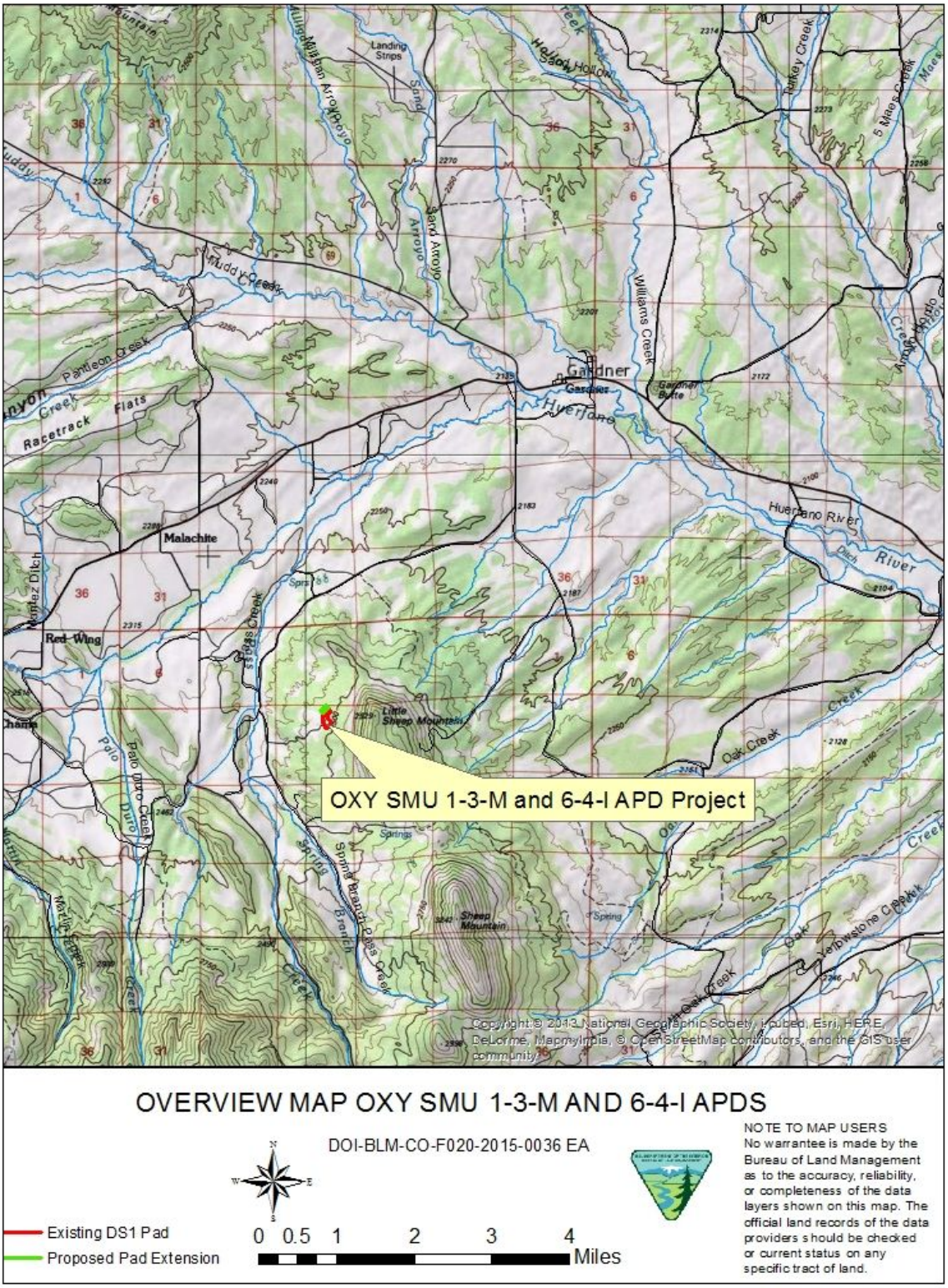
A closed loop system will be used for drilling and completion activities. Cuttings will be placed in a steel container; from there they will be hauled offsite to an appropriately state permitted landfill. Drilling, completion and any produced fluids will be contained in steel tanks and removed from the site where they will be re-used, or disposed of in accordance with all State and Federal laws.

Interim reclamation of the pad, and reclamation of the pipeline corridor will begin within 6 months (weather permitting) of completion of final well. Interim reclamation will consist of redistribution of excess soil, re-contouring the areas of the pad not needed for production as close to original as possible. All areas not needed for transportation of produced liquids and routine

maintenance would be re-vegetated with a seed mix and saplings approved by the surface owner. During the life of the project, the area will be monitored for presence of weeds, which if present, will be controlled by a licensed applicator.

Final reclamation of the project will begin within 6 months (weather permitting) of well plugging. Final abandonment will be completed in accordance with approved APD, which consists of proper plugging of wells, removal of all facilities and related equipment from the surface of the site. All areas will be returned to their original contour, reserve topsoil berm spread over the surface, and entire area reseeded with seed mix specified by the surface owner who uses this surface for cattle grazing.

Figure 2.1.



OVERVIEW MAP OXY SMU 1-3-M AND 6-4-I APDS

DOI-BLM-CO-F020-2015-0036 EA

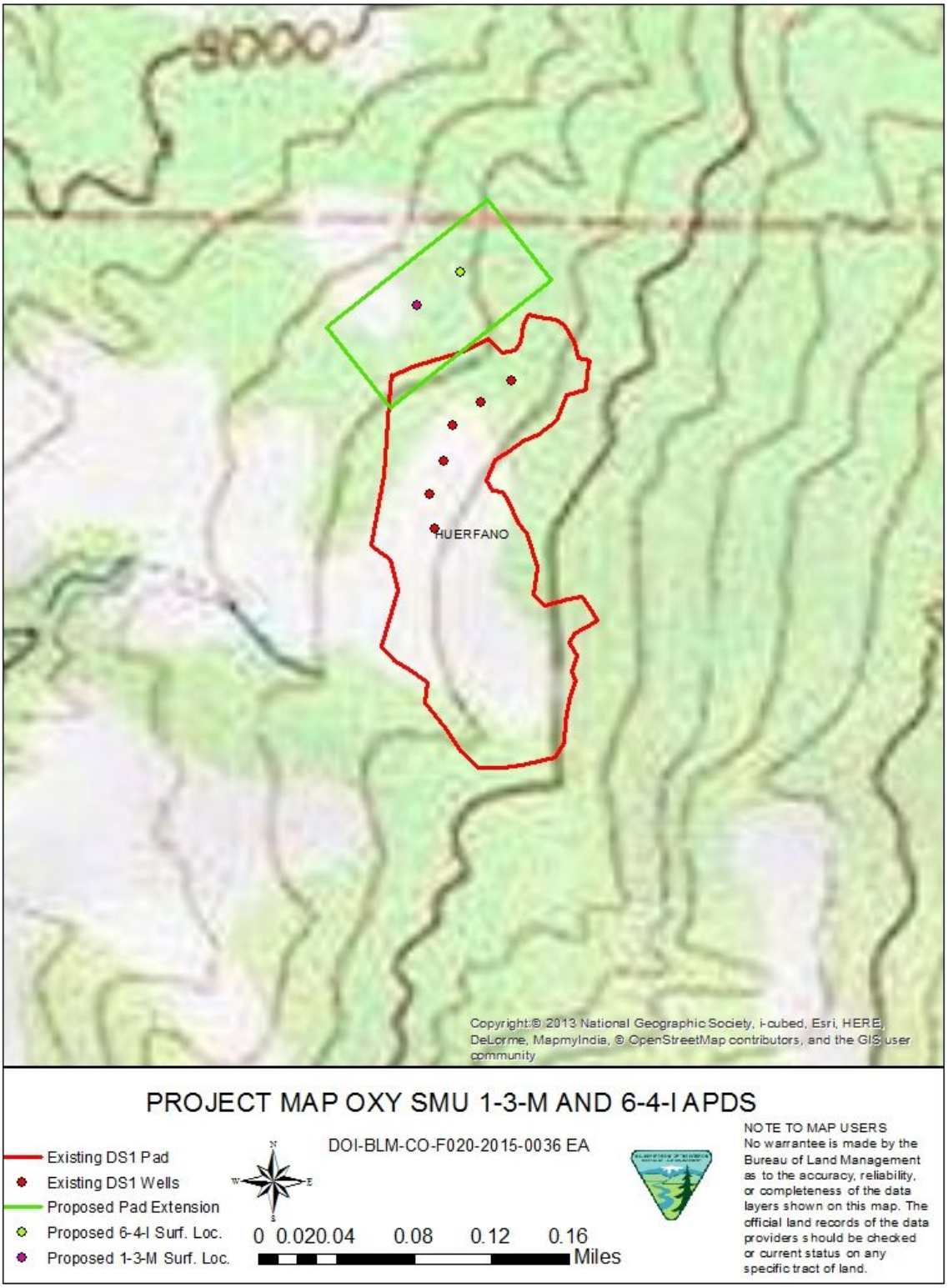
Existing DS1 Pad

Proposed Pad Extension

0 0.5 1 2 3 4 Miles

NOTE TO MAP USERS
No warrantee is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of the data layers shown on this map. The official land records of the data providers should be checked or current status on any specific tract of land.

Figure 2.2.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HUERFANO
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PROJECT MAP OXY SMU 1-3-M AND 6-4-I APDS
DOI-BLM-CO-F020-2015-0036 EA
Existing DS1 Pad
Existing DS1 Wells
Proposed Pad Extension
Proposed 6-4-I Surf. Loc.
Proposed 1-3-M Surf. Loc.
N
W
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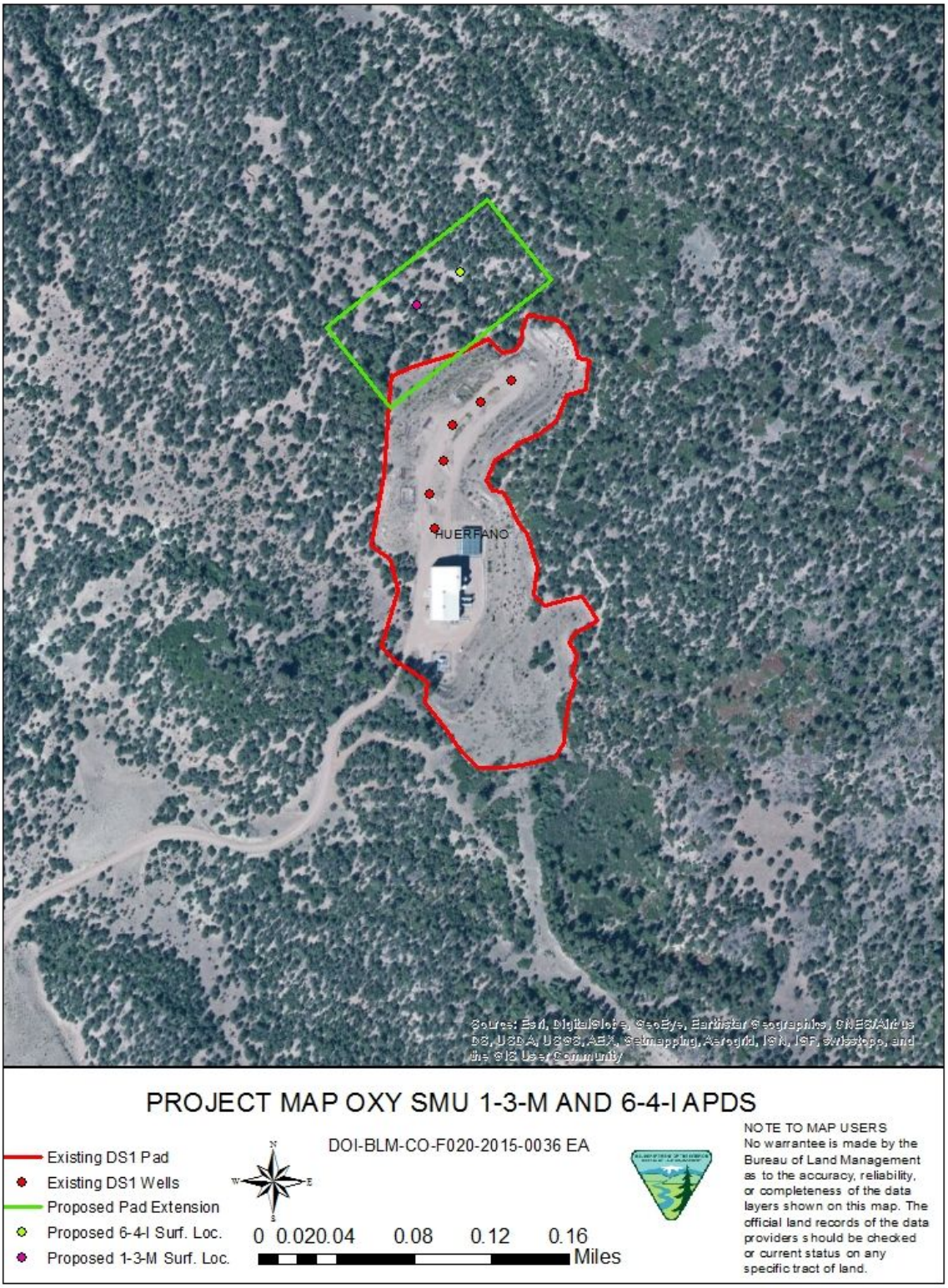
0 0.020.04 0.08 0.12 0.16
Miles
NOTE TO MAP USERS
No warrantee is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of the data layers shown on this map. The official land records of the data providers should be checked or current status on any specific tract of land.

Figure 2.3.


HUERFANO
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
PROJECT MAP OXY SMU 1-3-M AND 6-4-I APDS
DOI-BLM-CO-F020-2015-0036 EA
Existing DS1 Pad
Existing DS1 Wells
Proposed Pad Extension
Proposed 6-4-I Surf. Loc.
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Miles
NOTE TO MAP USERS
No warrantee is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of the data layers shown on this map. The official land records of the data providers should be checked or current status on any specific tract of land.

2.2.1. No Action Alternative

The proposed action involves federal subsurface minerals that are encumbered with federal oil and gas leases, which grant the lessee a right to explore and develop the leases. Although BLM cannot deny the right to drill and develop the leasehold, individual APDs can be denied. The no action alternative constitutes denial of the APDs associated with the proposed action. In this case, all proposed surface activity takes place on private surface over private minerals, therefore, denial of the APDs will not prevent development of the private minerals, or any other surface activity associated with this project.

2.3. Alternatives Considered

2.3.1. Alternatives Considered, but not Analyzed in Detail

Other alternatives were not considered due to the proposed project being a non-discretionary action being proposed on private surface over private mineral estate.

Chapter 3 Affected Environment and Effects

3.1. Introduction

3.1.1. Interdisciplinary Team Review

The following table is provided as a mechanism for resource staff review, to identify those resource values with issues or potential impacts from the proposed action and/or alternatives. Those resources identified in the table as impacted or potentially impacted will be brought forward for analysis.

Resource	Initial and date	Comment or Reason for Dismissal from Analysis
Air Quality Ty Webb, Chad Meister, Forrest Cook	FC, 3/16/2015	See Analysis
Geology/Minerals Stephanie Carter, Melissa Smeins	MJS, 3/17/ 2015	See Analysis
Soils John Smeins	AR, 3/26/2015	All infrastructure is already in place, action consists of expanding the existing pad. All disturbances would be constructed and reclaimed according to BLM Gold Book standards unless otherwise stipulated by the surface owner.
Water Quality Surface and Ground John Smeins	AR, 3/26/2015	See analysis
Invasive Plants John Lamman	JL, 2/26/2015	See analysis
T&E and Sensitive Species Matt Rustand	MR, 3/4/2015	There are no known records of threatened, endangered, or sensitive species within the action area.
Vegetation Jeff Williams, Chris Cloninger, John Lamman	JL, 2/26/2015	See analysis
Wetlands and Riparian Dave Gilbert	DG 2/12/13	Wetlands resources may be impacted during the water use period of drilling using the discussed spring water down-gradient on private lands.
Wildlife Aquatic Dave Gilbert	DG 2/12/12	Aquatic habitat associated with the discussed spring is unknown on private lands, but may decrease in value during the water use drilling period depending upon drying.
Wildlife Terrestrial Matt Rustand	MR, 3/4/2015	See Analysis
Migratory Birds Matt Rustand	MR, 3/4/2015	See Analysis

Resource	Initial and date	Comment or Reason for Dismissal from Analysis
Cultural Resources Monica Weimer	MMW, 2/12/15	One prehistoric site (5HF2672) and two prehistoric isolated finds (5HF2673 and 5HF2674) are present in the vicinity of the area of potential effect (see Report CR-RG-15-81 P). The phenomena are not eligible for the National Register of Historic Places, and therefore, do not qualify as historic properties. Therefore, no historic properties will be affected by the proposed undertaking.
Native American Religious Concerns Monica Weimer	MMW, 2/12/15	No possible traditional cultural properties were located during the cultural resources inventory (see above). There is no other known evidence that suggests the project area holds special significance for Native Americans.
Economics	AR 3/31/2015	Project is located in an established federal unit, with all infrastructure currently in place. Economic impacts would be limited to a slight temporary increase in demand for local services during drilling/construction, and slight increase in royalties to the federal government and participating mineral owners within the Sheep Mountain Unit, and severance taxes to state and local governments.
Paleontology Melissa Smeins, Stephanie Carter	MJS, 3/17/ 2015	Paleontological resources are not likely to be found in this area.
Visual Resources Kalem Lenard	LS, 3/31/15	The project would introduce additional landscape modifications that are similar to existing disturbances. This would not result in noticeable changes to the visual resources of the area and therefore there would be insignificant impacts.
Environmental Justice Martin Weimer	MW, 3/31/ 2015	The proposed action affects areas that are rural in nature. The land adjacent to the well site is a privately owned ranch, as a result, there are no minority or low-income populations in or near the project area. As such, the proposal will not have a disproportionately high or adverse environmental effect on minority or low-income populations.
Wastes Hazardous or Solid Melissa Smeins	MJS, 3/17/ 2015	See analysis
Recreation Kalem Lenard	LS, 3/3/2015	Private surface therefore recreation concerns not present
Farmlands Prime and Unique Jeff Williams, Chris Cloninger, John Lamman	JL, 2/26/2015	Not present
Lands and Realty	AR 3/31/15	N/A (Private Surface)
Wilderness, WSAs, ACECs, Wild & Scenic Rivers Kalem Lenard	LS, 3/3/2015	Not present
Wilderness Characteristics Kalem Lenard	LS, 3/3/2015	Not present

Resource	Initial and date	Comment or Reason for Dismissal from Analysis
Range Management Jeff Williams, Chris Cloninger, John Lamman	JL, 2/26/2015	Not present
Forest Management Ken Reed	AR 3/31/15	N/A (Private Surface)
Cadastral Survey		N/A (Private Surface)
Noise Martin Weimer	MW 3/31/2015	The project area is located in woodlands. Certain levels of noise are associated with drilling operations, these include drill rig operation, compressors/generators and general machine and vehicle operation. These impacts are temporary and terminate when drilling operations are complete.
Fire Ty Webb		N/A (Private Surface)
Law Enforcement Steve Cunningham		N/A (Private Surface)

The affected resources brought forward for analysis include:

- Air Quality
- Geology/ Minerals
- Water Quality
- Invasive plants
- Vegetation
- Wildlife Terrestrial
- Migratory Birds
- Waste Hazardous or Solid

3.2. Physical Resources

3.2.1. Air Quality and Climate

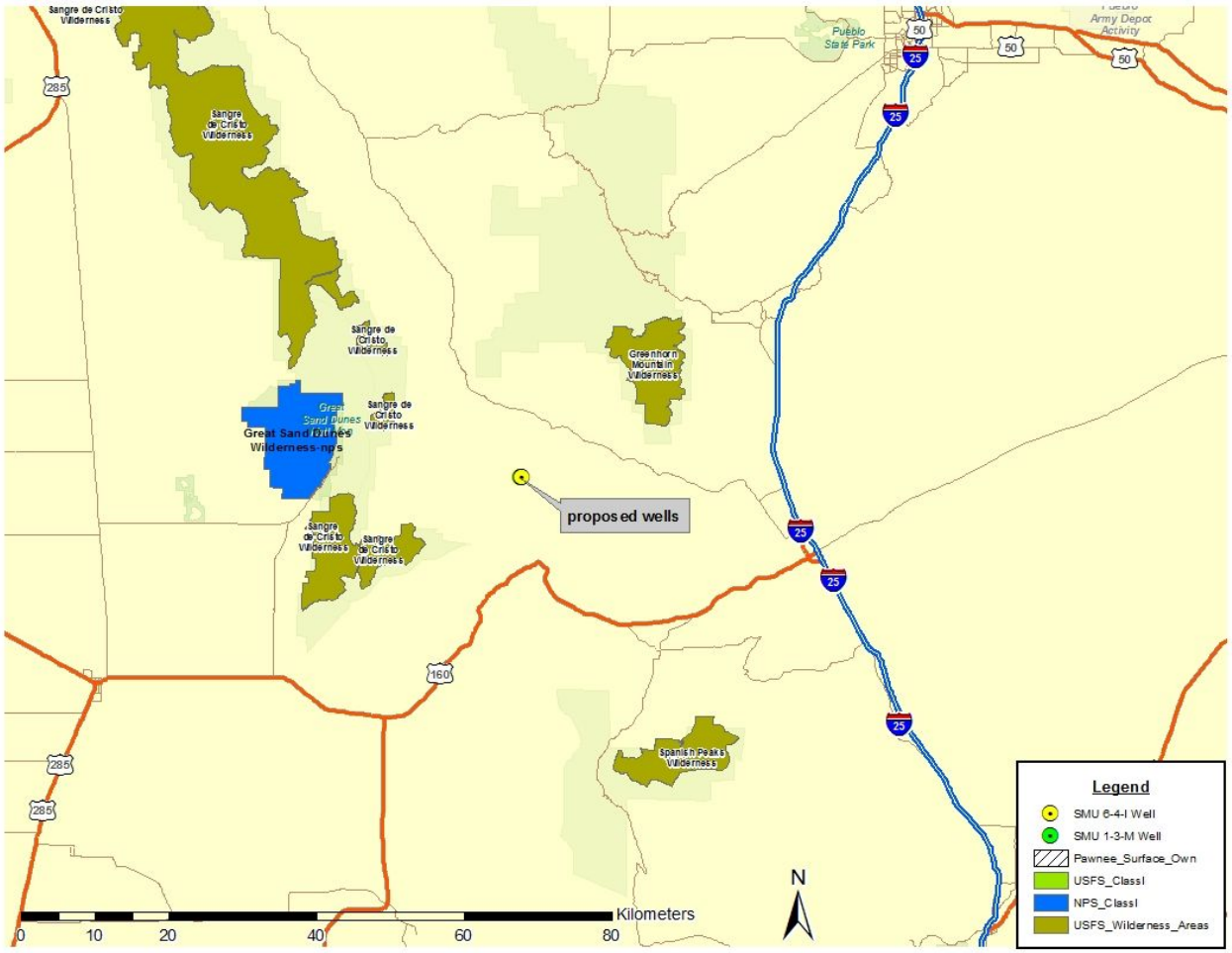
Affected Environment:

The proposed action is located in a very rural area of Huerfano County, Colorado about 20 miles west of Interstate 25 and 6 miles south of Gardner, Colorado. Mean temperatures in the area range from 22.3 degrees F in January to 87.7 degrees F in July. The area receives average annual precipitation of approximately 17.8 inches. Frequent winds in the area provide excellent dispersion characteristics for distributing anthropogenic emissions.

Activities occurring within the area that affect air quality include emissions from activities associated with nearby active wells, exhaust emissions from general traffic as well as fugitive

emissions from roads and agriculture (including biogenic sources). The following figure shows the proposed project location along with nearby Wildernesses and National Parks.

Figure 3–1 Proposed Project Location



Regulatory Framework: The Clean Air Act (CAA), which was last amended in 1990, requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for criteria pollutants. Criteria pollutants are air contaminants that are commonly emitted from the majority of emissions sources and include carbon monoxide (CO), lead (Pb), sulfur dioxide (SO2), particulate matter smaller than 10 & 2.5 microns (PM10 & PM2.5), ozone (O3), and nitrogen dioxide (NO2).

The CAA established 2 types of NAAQS:

Primary standards: – Primary standards set limits in order to protect public health, including the health of "sensitive" populations (such as asthmatics, children, and the elderly).

Secondary standards: – Secondary standards set limits in order to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings.

The EPA regularly reviews the NAAQS (every five years) to ensure that the latest science on health effects, risk assessment, and observable data such as incidence rates are evaluated in order to re-propose any NAAQS to a lower limit if the data supports the finding. The Colorado Air

Pollution Control Commission, by means of an approved State Implementation Plan (SIP) and/or delegation by EPA, can established state ambient air quality standards for any criteria pollutant that is at least as stringent as, or more so, than the federal standards. Ambient air quality standards must not be exceeded in areas where the general public has access. Table 3.1 lists the federal and state ambient air quality standards.

Table 3-1. Ambient Air Quality Standards (EPA 2014)

Pollutant[final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide[76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead[73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 µg/m3	Not to be exceeded
Nitrogen Dioxide[75 FR 6474, Feb 9, 2010][61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary andsecondary	Annual	53 ppb	Annual Mean
Ozone[73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution[Dec 14, 2012]	PM2.5	primary	Annual	12 µg/m3	Annual mean, averaged over 3 years
		secondary	Annual	15 µg/m3	Annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m3	98th percentile, averaged over 3 years
	PM10	primary andsecondary	24-hour	150 µg/m3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide[75 FR 35520, Jun 22, 2010][38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Very few “online” (currently operating) air quality monitors exist in south central Colorado. The following table provides air quality monitored values that could be used to assess the existing air quality in the region.

Table 3-2. Ambient Background Pollutant Concentrations

Pollutant / Units	O**3** Monitored Concentrations (Year 2013)			Colorado Monitoring Station Information
O**3** 8-hour (ppm)	0.072a	0.071b	0.083c	a. El Paso County (Manitou Springs) 4th maximum O3 8-hour. b. Chaffee County (Trout Creek Pass) 4th maximum O3 8-hour. c. Douglas County (Roxborough State Park) 4th maximum O3 8-hour.
Pollutant / Units	NO**2** Monitored Concentrations (Year 2013)			Colorado Monitoring Station Information

NO**2** 1-hour (ppb)	35a	68b	24c	a. La Plata County (7571 Hwy. 5505) 98th percentile NO2 1-hour. b. Denver County (2105 Broadway) 98th percentile NO2 1-hour. c. Rio Blanco County (Rangely) 98th percentile NO2 1-hour.
Pollutant / Units	Particulate Matter Background Monitored Concentrations (Year 2013)			Colorado Monitoring Station Information
PM**10** 24-hour (µg/m3)	193a	37b	406c	a.Alamosa County (Alamosa) 2nd maximum 24-hour average PM10 concentration. b.Gunnison County (Mount Crested Butte) 2nd maximum 24-hour average PM10 concentration. c.Prowers County (Lamar) 2nd maximum 24-hour average PM10 concentration.
PM**2.5** 24-hour (µg/m3)	17a	18b	17c	a.Pueblo County (Pueblo) 98th percentile 24-hour average PM2.5 concentration. b.El Paso County (Colorado Springs) 98th percentile 24-hour average PM2.5 concentration. c.Douglas County (Roxborough State Park) 98th percentile 24-hour average PM2.5 concentration .
PM**2.5** Annual (µg/m3)	6.5a	6b	5.6c	a.Pueblo County (Pueblo) weighted annual mean PM2.5 concentration. b.El Paso County (Colorado Springs) weighted annual mean PM2.5 concentration. c.Douglas County (Roxborough State Park) weighted annual mean PM2.5 concentration.
µg/m3 = micrograms per cubic meter ppm = parts per million ppb = parts per billion O3 = οζονε				
NO2 = nitrogen dioxide				
PM10 / PM2.5 = particulate matter less than or equal to 10 microns / 2.5 microns in size				

The CAA and the Federal Land Policy and Management Act of 1976 (FLPMA) require BLM and other federal agencies to ensure actions taken by the agency comply with federal, state, tribal, and local air quality standards and regulations. FLPMA further directs the Secretary of the Interior to take any action necessary to prevent unnecessary or undue degradation of the lands [Section 302 (b)], and to manage the public lands "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values" [Section 102 (a)(8)].

The subject activity construction / development phase is projected to last approximately 60 days. The life of the well, if economically viable, would be expected to sustain operations for approximately 20 – 30 years once production begins. Maximum foreseeable direct and indirect cumulative emissions would occur at the beginning of the project during the proposed wells construction phase when emissions from non-project related nearby sources are also being emitted.

The proposed project area (see Figure 3-1) is designated as a Class II Area, as defined by the Federal Prevention of Significant Deterioration (PSD) provision of the CAA. The PSD Class II designation allows for moderate growth or degradation of air quality within certain limits above

baseline air quality. The closest Class I area to the proposed well site locations is Great Sand Dunes National Monument, which lies approximately 16 miles to the west.

Environmental Effects - Proposed Action

Direct and Indirect Impacts: In general the proposed action will have a temporary negative impact to air quality which will mostly occur during the construction phase. Utilization of the access road, surface disturbance, and construction activities such as drilling, well completion, and equipment installation will all impact air quality through the generation of dust related to travel, transport, and general construction. This phase will also produce short term emissions of criteria, hazardous, and greenhouse gas pollutants from vehicle and construction equipment exhausts. Once construction is complete, the daily activities at the site will be reduced to engines and operational and maintenance checks which may be as frequent as a daily visit. Production phase emissions will result from compressor engines and vehicle exhausts from the maintenance and process technician visits.

Ozone is not directly emitted like other criteria pollutants. Ozone is chemically formed in the atmosphere via interactions of oxides of nitrogen (NOX) and volatile organic compounds (VOCs) in the presence of sunlight and under certain meteorological conditions (NOX and VOCs are ozone precursors). Ozone formation and prediction is complex, generally results from a combination of significant quantities of VOCs and NOX emissions from various sources within a region, and has the potential to be transported across long ranges. Therefore, it is typically not appropriate to assess (i.e. model) potential ozone impacts of a minor project on potential regional ozone formation and transport. However, the State of Colorado assesses potential ozone impacts from its authorizing activities on a regional basis when an adequate amount of data is available and where such analysis has been deemed appropriate. For this reason (inappropriate scale of analysis), ozone will not be further addressed in this document beyond the related precursor discussions and an appropriate qualitative analysis/comparison to background Weld County emissions inventories.

Emission estimates from the proposed wells were calculated for this EA, and are disclosed in Table 3-3 below. The emissions inventories (EI) considered reasonably foreseeable development activities for the proposed wells, and includes emissions from both construction and production operations. The following pollutants were inventoried where an appropriate basis, methodology, and sufficient data exists: CO, NOX (includes NO2), PM2.5, PM10, SO2, VOCs, HAPs, CO2, CH4, and N2O. The EI was developed using reasonable but conservative scenarios for each activity. Production emissions were calculated based on full production activity for an entire year. Potential emissions were calculated for new project wells assuming the minimum/basic legally required emissions control measures, and common practices and equipment configurations data that was provided by operators in the region.

The following assumptions were applied consistently to all potential activities for estimating potential emissions for proposed action:

- The EI used a disturbed surface area of eight acres for initial well-pad expansion surface disturbance and one acre for well-pad production phase (post reclamation) wind erosion calculations. No new roads or pipelines would be required.

- All existing roads are surfaced with packed road base and disturbed surfaces (pads and access roads) would receive appropriate application of water during construction and development (i.e. drilling) phase and emissions calculations assume additional dust control efficiency.

- All diesel fuel would be standard #2 grade (500 ppm sulfur) or better.
- Drill rigs, completion and fracing engines emissions are based on EPA Non-road Tier 1 emissions standards.
- CO2 gas processing engines (compressor) for the proposed action will be powered by grid electricity.

Table 3–3 Estimated Maximum Annual Emissions

Activity	Annual Emissions (Tons)											
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	HAPs	CO_2	CH_4	N_2O	CO_{2eq}	CO_{2eq} metric tonnes
Well Pad Construction - Fugitive Dust	0.224	0.022	–	–	–	–	–	–	–	–	–	–
Heavy Equipment Combustive Emissions	0.709	0.688	28.595	0.472	3.691	1.410	0.141	2,447.643	0.138	0.062	2,469.683	2,241.092
Commuting Vehicles - Construction	1.552	0.156	0.013	0.000	0.021	0.008	0.001	3.230	0.000	0.000	3.312	3.006
Wind Erosion	2.427	0.364	–	–	–	–	–	–	–	–	–	–
Sub-total: Construction	4.912	1.230	28.608	0.472	3.712	1.418	0.142	2,450.873	0.138	0.062	2,472.995	2,244.097
Well Workover Operations - Fugitive Dust	0.110	0.011	–	–	–	–	–	–	–	–	–	–
Well Workover Operations - On-site Exhaust	0.000	0.000	0.005	0.002	0.046	0.002	0.000	9.340	0.000	0.000	9.376	8.508
Well Workover Operations - On-road Exhaust	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.313	0.000	0.000	0.314	0.285
Well Visits for Inspection & Repair - Operations	1.593	0.159	0.006	0.000	0.012	0.001	0.000	5.016	0.000	0.000	5.030	4.565
Station Visits - Operations	0.209	0.021	0.001	0.000	0.001	0.000	0.000	0.610	0.000	0.000	0.612	0.555
Sub-total: Operations	1.913	0.192	0.012	0.002	0.060	0.003	0.000	15.280	0.000	0.000	15.332	13.913
Road Maintenance	0.088	0.009	0.007	0.000	0.003	0.001	0.000	1.061	0.000	0.000	1.065	0.966
Sub-total: Maintenance	0.088	0.009	0.007	0.000	0.003	0.001	0.000	1.061	0.000	0.000	1.065	0.966
Road Reclamation	0.022	0.003	0.003	0.000	0.003	0.000	0.000	0.744	0.000	0.000	0.746	0.677
Well Reclamation	0.061	0.008	0.011	0.000	0.010	0.002	0.000	2.715	0.000	0.000	2.724	2.472
Sub-total: Reclamation	0.083	0.011	0.013	0.001	0.013	0.002	0.000	3.458	0.000	0.000	3.470	3.149
Total Emissions	6.997	1.442	28.641	0.475	3.788	1.424	0.142	2,470.672	0.138	0.062	2,492.861	2,262.125

Table 3-3 emissions account for full year of production associated with 2 new wells and also includes construction / development phase activities emissions for 2 additional new wells.

As shown in Table 3-3, the bulk (~ 70%) of the particulate matter and (~ 99%) NOx emissions occur during the short-term construction / development period and production phase PM emissions are primarily related to well-pad visits unpaved road traffic.

Table 3-4 below demonstrates a relative comparison of the project emissions to Huerfano County's emissions from 2010.

Table 3-4. Proposed Action & Huerfano County Emissions Comparisons1

Pollutant	Emissions, Tons per year (Max)		
	2 – Project Wells	Huerfano County Total Emissions (2010)	Huerfano County Oil & Gas Point Emissions (2010)
NOX	28.64	1,493	5.34
CO	3.79	6,849	9.26
VOC	1.42	17,428	114.17
PM10	7.0	1,409	0.14
PM2.5	1.44	No data	No data
SOX	0.48	43	0.01
HAPs	0.14	18	3.73

1 CDPHE 2010 APEN Online Emissions Inventory (most current available). CDPHE HAP inventory is for benzene only.

The emissions estimates for a typical well, as shown above, are below the CDPHE required minor source air quality modeling levels. The BLM COSO recently completed two near-field

air quality modeling analyses for oil and gas construction and production emissions levels much higher than the levels for the Proposed Action. Predicted concentrations for those analyses were below applicable air quality standards. The nearest ambient air receptor for those analyses were less than ½ mile from the emissions sources. The nearest ambient (residence) receptor from the facility / well pad for the proposed action is at least one mile away (proposed project is located on a private ranch and there is no public access to the project area). For these reasons, near-field air quality modeling was not conducted for the proposed development and operations at the facility / well-pad level. For determining potential impacts associated with proposed action – related traffic on unpaved public roads, the BLM COSO near-field impacts screening tool was input with construction / development related traffic emissions for a typical well development project. The near-field modeling tool shows that dust impacts along public unpaved roads are generally acceptable when water (or product with equivalent control efficiency of at least 50%) is routinely applied to the unpaved roads during the construction / development phase.

Greenhouse Gas Emissions and Climate Change: According to the U.S. Global Change Research Program (2009), global warming is unequivocal, and the global warming that has occurred over the past 50 years is primarily human-caused. Standardized protocols designed to measure factors that may contribute to climate change, and to quantify climatic impacts, are presently unavailable. Moreover, specific levels of significance have not yet been established by regulatory agencies. Predicting the degree of impact any single emitter of GHGs may have on global climate, or on the changes to biotic and abiotic systems that accompany climate change is highly complex, has considerable uncertainty, and requires intense computer modeling (i.e., super computers). As such, no readily available tools exist to predict impacts a project's emissions would have on the global, regional, or local climate. This analysis is therefore limited to comparing the context of total project GHG emissions, and to emissions recently analyzed by EPA. The analysis also discloses readily available information regarding expected changes to the global climatic system and any empirical evidence of climate change that has occurred to date (see cumulative impacts).

The implementation of the Proposed Action Alternative is estimated to contribute 2,262 metric tons of carbon dioxide equivalent (CO2(e)) in the maximum year. Annual construction / development GHG emissions will be 99% of the total emissions shown for the maximum year (see Table 3-3). Over a 25 year timeframe, the total GHG emissions expected are approximately 2,619 metric tons CO2(e) for the 2 new wells. The total provided does not account for the ultimate use or consumption of any produced minerals at this time due to the fact that the ultimate form of use and any additional processing required to render the product to sufficient quality (which would cause changes to the quantity of product) cannot be predicted with any reasonable certainty. Additionally, it should be noted that production values (also estimated at this time) could vary significantly over the life of the project, making any prediction of the quantities of GHG emitted highly speculative.

The CDPHE used the EPA's State Inventory Tool to estimate future years GHG emissions inventories for Colorado. In year 2020, it is estimated that Colorado's annual GHG emissions will be approximately 128,060,000 metric tons CO2(e). The proposed action annual production phase (post-development) GHG emissions would represent < 0.0001 % of the state of Colorado's year 2020 annual GHG emissions. Given the relative magnitude of greenhouse gas emissions associated with the development of the two proposed wells as compared to the state's projected GHG emission levels, the GHG contribution associated with the proposed wells is extremely small.

To provide additional context, the EPA has recently modeled global climate change impacts from a model source emitting 20% more GHGs than a 1500MW coal-fired steam electric generating plant (approx. 14,132,586 metric tons per year of CO2, 273.6 metric tons per year of nitrous oxide, and 136.8 metric tons per year of methane). It estimated a hypothetical maximum mean global temperature value increase resulting from such a project. The results ranged from 0.00022 and 0.00035 degrees Celsius occurring approximately 50 years after the facility begins operation. The modeled changes are extremely small, and any downsizing of these results from the global scale would produce greater uncertainly in the predictions. The EPA concluded that even assuming such an increase in temperature could be downscaled to a particular location, it "would be too small to physically measure or detect", see Letter from Robert J. Meyers, Principal Deputy Assistant Administrator, Office of Air and Radiation re: "Endangered Species Act and GHG Emitting Activities (Oct. 3, 2008). The project emissions are a fraction of the EPAs modeled source and are shorter in duration, and therefore reasonable to conclude that the project would have no measurable impact on the climate.

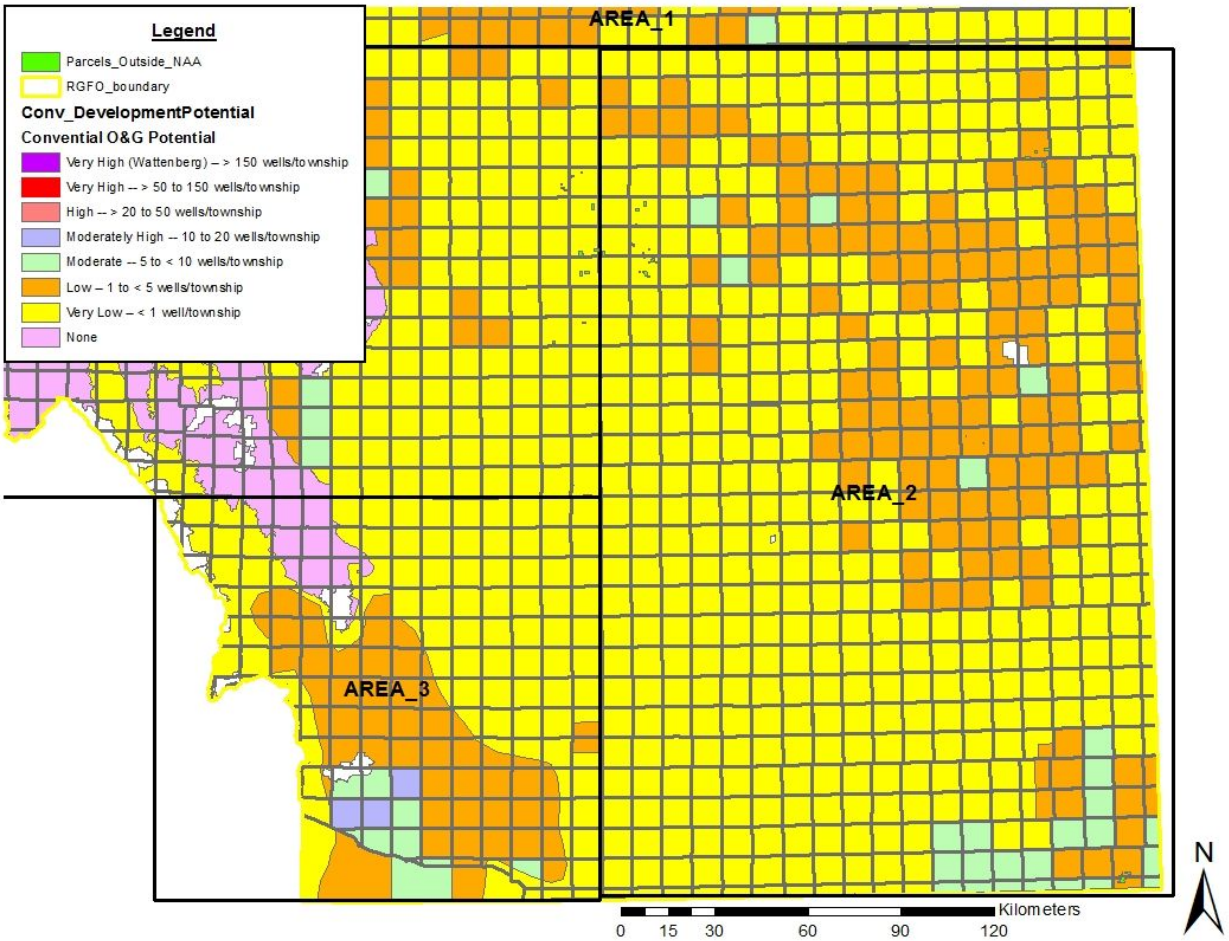
Cumulative Impacts: The area currently has a high degree of alteration in the form of agricultural fields and roads. The addition of the infrastructure needed to construct and drill the additional proposed wells would have a minimal cumulative impact to the area's air quality given the location of the proposed action and the total cumulative emissions level for the area.

CARMMS: The following figure / plot shows a GIS layer for conventional oil and gas Reasonable Foreseeable Development (RFD) projections developed by the BLM based on oil and gas operator projections. The proposed project well pads are located in an area of "low" (1-5 new wells per township: orange shaded) oil and gas development potential over the next ~ 20 years, and are located in the middle of "AREA_3" emissions source group for the Colorado Air Resources Management Modeling Study (CARMMS). The CARMMS utilizes the Comprehensive Air-quality Model with extensions (CAMx) to assess statewide impacts to air quality and air quality related values from projected oil and gas development out to year 2021 for three oil and gas development scenarios (low, medium, and high). Projections for development are based on either the most recent BLM field office Reasonably Foreseeable Development (RFD) document (high), or by projecting the current 5 year average development paces forward to 2021 (low). The medium scenario will include the same well count projections as the high, but will assume additional emission restrictions, where the high / RFD scenario assumed current development practices and "on the books" emissions controls and regulations (2013). Each BLM field office / planning area was modeled with CAMx source apportionment technology (RGFO was broken into four development areas due to size), meaning that incremental impacts to air pollution, regional ozone and AQRVs from emissions sources in these planning areas are essentially tracked to better understand the significance of such development on impacted resources and populations. The CARMMS project leverages the work completed by the WestJumpAQMS, and the base model platform and model performance metrics are based on those products (2008). The CARMMS high / RFD modeling scenario will be used to describe potential air quality impacts for ~ 10 years of future projected Federal oil and gas development for RGFO Area #3 and cumulative air pollutant emissions sources.

Years 2011 and 2021 oil and gas emissions inventories were developed for RGFO "Area #3" for the CARMMS based on oil and gas RFD as shown in the following figures. The table following the figures shows the total (Federal and non-Federal) oil and gas emissions inventory estimates that were modeled for the CARMMS RFD Scenario for RGFO Area #3. It is reasonable to assume that emissions associated with the proposed project and any other potential oil and gas

developed through year 2021 are accounted for in the CARMMS projected year 2021 oil and gas emissions inventories as shown.

Table 3-6. RGFO Area #3 O&G Emissions (Tons) – CARMMS RFD Scenario



CARMMS - RGFO Area ID	Year	PM**10**	PM**2.5**	VOC	CO	NO**X**	SO**2**
Area #3	2011	363	95	2,333	10,983	8,648	4
	2021	514	125	2,924	14,101	11,206	5

The CARMMS RFD (High) modeling scenario provides an upper-bound look at impacts that would cover all potential oil and gas development based on aggressive development forecasts. The following table presents the highest PSD pollutant concentrations at any Class I area due to the projected CARMMS RFD scenario new Federal oil and gas emissions for the entire RGFO (including Area #3). All PSD pollutants contributions from the projected wells and emissions associated with the RGFO source apportioned group are less than 2% of any PSD increment and are thus exceedingly low. The PSD program is a Clean Air Act permitting program for new and modified major air pollution sources and is administered in Colorado by the CDPHE Air Pollution Control Division (APCD). In this air quality assessment, PSD increment consumption comparisons are provided to evaluate the extent of environmental effects only, and do not constitute a regulatory consumption analysis.

Table 3-7: CARMMS RFD Year 2021- RGFO New Federal O&G – Max PSD Consumption at Any Domain Class I Area

Source Group	PSD Class I Increment	Max @ any Class I Area	Percent of PSD Class I Increment	Class I Area where Max occurred
NO2 Annual	2.5	0.004	0.1%	Great_Sand_Dunes
PM10, 24-hour	8	0.044	0.6%	Rocky_Mountain
PM10, Annual	4	0.002	0.0%	Rocky_Mountain
PM2.5, 24-hour	2	0.023	1.1%	Rocky_Mountain
PM2.5, Annual	1	0.001	0.1%	Rocky_Mountain
SO2, 3-hour	25	0.001	0.0%	Rocky_Mountain
SO2, 24-hour	5	0.000	0.0%	Rocky_Mountain
SO2, Annual	2	0.000	0.0%	Rocky_Mountain

The following table provides a quasi-cumulative summary of ozone, visibility and nitrogen deposition impacts for new projected RGFO Federal oil and gas emissions (since year 2011) in CARMMS Area #3 associated with the RFD (High) modeling scenario. These impacts show the relative contribution to full cumulative (all world-wide emissions sources) impacts for the projected year 2021 RGFO Area #3 oil and gas emissions associated with the RFD (high) modeling scenario.

Table 3-8: CARMMS RFD Year 2021- RGFO New Federal O&G Contribution to Modeled AQRV Impacts

Source Group	Number of Annual Days Above 0.5 dv Change	Maximum Modeled Annual Nitrogen Deposition (kg/ha-yr)	Maximum 4th High Daily 8-hour Ozone Contribution (ppb)
RGFO Area # 3	0	0.0272 (Greenhorn Mtns.)	0.2

* maximum modeled concentrations / values for any Class I / sensitive Class II area (AQRV) or grid cell (ozone) within the CARMMS 4km modeling domain (includes all of Colorado).

As shown in the table above, there are no days that the projected new RGFO Area #3 year 2021 Federal oil and gas emissions (since year 2011) have a significant (~ 0.5 dv) visibility change impact at any Class I or sensitive Class II area and the maximum modeled nitrogen deposition contributions are minimal with respect to the cumulative critical nitrogen deposition load of 1.5 kg/ha-yr value. The maximum contribution to the 4th high daily maximum 8-hour concentrations is minimal with respect to the 75 ppb 8-hour ozone standard. The information above shows that the predicted air quality impact contributions associated with an aggressive 10-year oil and gas development scenario for the RGFO Area #3 are minimal, and it is reasonable to conclude that the proposed project would have much lower contributions to the overall cumulative air quality.

For a Project, the ANC Level of Acceptable Change (LAC) threshold is no change greater than 10% for lakes with base ANC > 25 μeq/l and no change greater than 1 μeq/l for lakes with base ANC values < 25 μeq/l. The ANC calculations due to nitrogen and sulfur deposition from the RGFO Federal O&G RFD scenario is shown in Table 3-9 below. Specifically, the table shows all of the lakes where the delta in ANC % showed a change as a result of the new projected RGFO Federal oil and gas emissions (since year 2011) associated with the CARMMS RFD modeling scenario. All of the values are below the USFS ANC LAC threshold at all sensitive lakes. The USDA Forest Service methodology reports both Delta ANC calculations and LAC thresholds as positive quantities; however they reflect a decrease in lake ANC.

Table 3-9: CARMMS RFD Year 2021- RGFO New Federal O&G – ANC Changes

National Forest	**Wilderness Area - Lake**	10th Percentile Lowest ANC Value (µeq/L)	Delta ANC (%)	Delta ANC (meq/L)	USFS LAC Threshold	Below Threshold?
Arapaho and Roosevelt	Indian Peaks - Blue	19.3	0.0299%	0.0058	<1(µeq/L)	Yes
Arapaho and Roosevelt	Mount Evans – Upper Middle Beartrack	50.9	0.0309%	0.0157	<10%	Yes
San Juan-Rio Grande	Weminuche – White Dome Lake	2.1	0.0304%	0.0006	<1(µeq/L)	Yes

*Highest impacts (associated with CARMMS RFD Scenario new RGFO Federal O&G) for top three lakes (with respect to highest Delta ANC percent change) for all sensitive lakes within CARMMS 4km modeling domain.

The following table provides a full cumulative summary of ozone, visibility and nitrogen deposition impacts for all (i.e. world-wide) new and existing emissions sources associated with the CARMMS RFD (High) year 2021 modeling scenario.

Table 3-10: CARMMS Modeled AQRV Impacts - High 2021 Scenario - Full Cumulative Emissions Inventory

Class I Area	**Best 20% Days Visibility Metric (dv) - 2021 High Improvement from 2008**	**Worst 20% Days Visibility Metric (dv) - 2021 High Improvement from 2008**	**Modeled Annual Nitrogen Deposition (kg/ha-yr)**
Rocky Mountain NP	-0.09	0.86	2.57
Great Sand Dunes NP	-0.06	0.42	2.08

* positive visibility related values mean overall visibility improvement and deposition values are average for all grid cells making up the Class I area.

As shown in the table above, the model predicted that the highest impacted Class I areas (relative to potential RGFO oil and gas development) would see improvements for worst visibility days and could see slight (< 0.1 dv) degradation for best visibility days. Modeled year 2021 annual nitrogen deposition for Rocky Mtn. NP compares well to the total actual observed nitrogen deposition values for years 2008-2012, suggesting little change in cumulative deposition from baseline years to future year 2021. Using the baseline / current years monitored nitrogen and sulfur deposition rates data with year 2021 CARMMS cumulative modeling results, it is reasonable to conclude that the ANC of Lakes within the immediate area in year 2021 would be similar to baseline / current ANC conditions.

For full cumulative ozone design value projections at regional ozone monitoring sites, the maximum current year 8-hour ozone design concentration (DVC; based on 2006-2010 observations) is 82.0 ppb at the Rocky Flats North (CO_Jefferson_006) monitor that is projected to be reduced to 79.5 ppb for the CARMMS 2021 High Development Scenario. With the exception of the Larimer County, Colorado monitors, modeled ozone predictions at all monitors within the modeling domain result in lower future 2021 values. For the ozone design value projection unmonitored area analysis (analysis for areas with no monitors), the geographical extent (i.e. size) of the overall area of ozone design value exceedances is reduced (from year 2008 to 2021) and CARMMS plots show the largest ozone reductions in the Denver and Salt Lake City areas and ozone increases in Garfield County, Colorado.

The CARMMS incremental modeling results for each source group (i.e. RGFO Area #3) are applicable for the amount of additional emissions that were modeled in the Study. Annual oil and gas completions / development inventories (post year 2011) are being compiled to ensure that current and future oil and gas development does not exceed the acceptable rates as modeled in CARMMS. Since year 2011, it appears that there have been approximately ~ 10 new Federal wells developed in RGFO Area #3 for years 2012-2014 (including three approved / processed year 2014 APDs); and this total is much lower than the ~ 60 new Federal wells for RGFO Area #3 as modeled for CARMMS year 2021 RFD scenario (new development for years 2012 through 2021). In addition, as future oil and gas development occurs (including the proposed project) in the RGFO, project-specific emissions (based on approved APDs) are being added to the total regional emissions estimates (all emissions sources: oil and gas emissions and more) to compare regional emissions rates modeled in cumulative air quality modeling studies (CARMMS) along with the corresponding modeling results to confirm that activities approved by the BLM Colorado are within the modeled emissions analyzed in the cumulative analyses.

Greenhouse Gas Emissions and Climate Change: With respect to Climate Change, the following predictions were identified by the EPA for the Mountain West and Great Plains region:

- The region will experience warmer temperatures with less snowfall.
- Temperatures are expected to increase more in winter than in summer, more at night than in the day, and more in the mountains than at lower elevations.
- Earlier snowmelt means that peak stream flow will be earlier, weeks before the peak needs of ranchers, farmers, recreationalist, and others. In late summer, rivers, lakes, and reservoirs will be drier.
- More frequent, more severe, and possibly longer-lasting droughts will occur.
- Crop and livestock production patters could shift northward; less soil moisture due to increased evaporation may increase irrigation needs.
- Drier conditions will reduce the range and health of ponderosa and lodge pole pine forests, and increase the susceptibility to fire.
- Grasslands and rangelands could expand into previously forested areas.
- Ecosystems will be stressed and wildlife such as the mountain line, black bear, long-nose sucker, marten, and bald eagle could be further stressed.

If these predictions are realized as mounting evidence suggests is already occurring, there could be impacts to resources within the region. For example, if global climate change results in a warmer and drier climate, increased particulate matter impacts could occur due to increased windblown dust from drier and less stable soils. Warmer temperatures with decreased snowfall could have an impact on a particular plants ability to sustain itself within its current range. An increased length of growing season in higher elevations could lead to a corresponding variation in vegetation and change in species composition. These types of changes would be most significant for special status plants that typically occupy a very specific ecological niche. Cool season plant species' spatial ranges are predicted to move north and to higher elevations, and extinction of endemic threatened or endangered plants may be accelerated. Invasive plant species would be more likely to out-compete native species.

Increases in winter temperatures in the mountains could have impacts on traditional big game migration patterns. Due to loss of habitat, or due to competition from other species whose ranges may shift northward, the population of some animal species may be reduced. Warmer winters with less snow would impact the Canada lynx by removing a competitive advantage they have over other mountain predators. Earlier snowmelt could also have impacts on cold water fish species that occupy streams throughout the planning area. Climate change could affect seasonal frequency of flooding and alteration of floodplains, which could impact riparian conditions. More frequent and severe droughts would have impacts on many wildlife species throughout the region as well as vegetative composition and availability of livestock forage in some areas. Climate change could increase the growing season within the region, however, so longer growing season in theory would result in more forage production provided there is sufficient precipitation. Drier conditions could have severe impacts on forests and woodlands. This could leave these forests and woodlands more susceptible to insect damage and at higher risk of catastrophic wildfires. Increased fire activity and intensity would increase greenhouse gas emissions.

Protective / Mitigation Measures Multiple near-field modeling assessments (including application of BLM COSO near-field impacts screening tool as described earlier) performed by the BLM Colorado for Colorado-based oil and gas air quality assessments indicate that routine water (or product with equivalent dust control efficiency) application to unpaved surfaces is necessary during the oil and gas development / construction phase to achieve air quality compliance even though construction phases last just a few weeks. The short-term particulate matter air quality standards do not allow for many exceedances per year and therefore could be exceeded multiple times with only a couple of weeks of construction activities emissions not controlled.

It is anticipated that the operator would apply for either an APCD air permit for the site as a whole, or cover individual equipment under one of Colorado's general permits for oil and gas operations. The state as the regulatory authority for oil and gas actions requires controls of emissions and standards for compliance that the operator will be subject to. It is expected that the operator will comply with the requirements and make every effort to minimize emissions through good engineering and operating practices to the maximum extent practical.

In addition to the existing state and federal requirements, the following BLM requirements will apply:

- Applicant will continuously apply water or dust-suppressant to public unpaved surfaces that access the new well pad / facility likely to be disturbed during construction / well development phase.

No Action Alternative:

Direct and Indirect Impacts:

None

Protective/Mitigation Measures:

None

3.2.2. Geologic and Mineral Resources

Affected Environment:

The proposed wells are located within the Sheep Mountain Unit located on the eastern margin of the Sangre de Cristo range. Sheep Mountain is a natural CO2 production area. Geology of the area consists of incomplete Mesozoic and Paleozoic sections of various marine to non-marine limestones, sandstones, conglomerates and shales. In addition to sedimentary rocks, numerous dikes and sills are also present. The geologic structure is complex with numerous folds and faulting. The reservoir rocks are Cretaceous Dakota and Jurassic Entrada sandstones capped by cretaceous marine sediments and a laccolith. Thrust faulting causes this section to repeat several times. Repeat sections of both the Dakota and Entrada may have the same reservoir pressures in the deeper sections as the first set of sections above the fault, resulting in lost circulation. Total cumulative production is 34 billion m3. Gas composition is 97% CO_2 . Most of the CO_2 gas produced at this location is transported to West Texas to support oil and gas production.

Groundwater resources in the proposed project area include the Purgatoire, Dakota and Entrada Sandstones and the Poison Canyon sandstone.

In addition to Carbon Dioxide, uranium resources may be found in the Poison Canyon Formation of Huerfano County, although uranium prospecting operations in the 1960s did not locate any resources in the Sheep Mountain area. Several sand and gravel pits have also been developed within five miles of the proposed wells.

Environmental Effects

Proposed Action:

Direct and Indirect Impacts:

The Proposed Action would drill through the several groundwater aquifer units to produce carbon dioxide from underlying formations. During drilling operations on parcels, loss of circulation or problems cementing the surface casing could directly affect freshwater aquifer and mineral zones encountered. Known water-bearing zones in the APD areas would be protected by drilling requirements and, with proper practices, contamination of ground water resources is highly unlikely.

Protective/Mitigation Measures:

Onshore Order #2 requires that the proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones and prospective mineral zones. At the APD stage, geologic and engineering reviews will be completed to ensure that cementing and casing programs are adequate to protect all downhole resources. Known water bearing zones in the APD area are protected by drilling requirements and, with proper practices, contamination of ground water resources is highly unlikely. Casing along with cement would be extended well beyond fresh-water zones to ensure that drilling fluids remain within the well bore and do not enter groundwater.

Cumulative Impacts:

Cumulative impacts on geology and minerals resources would primarily occur as a result of development, which would irreversibly deplete recoverable carbon dioxide from the producing formations.

No Action Alternative:

Direct and Indirect Impacts: None

3.2.3. Hydrology/Water Quality

Surface, Groundwater, Floodplains

Affected Environment:

The proposed wells would be located on a relatively high elevation bench at approximately 8800' in the Huerfano River watershed. Groundwater in this area consists mainly of shallow alluvial or valley-fill aquifers tributary to the Huerfano River. These aquifers are used for domestic and agricultural purposes.

Environmental Effects

Proposed Action

Direct and Indirect Impacts: Oxy estimates that approximately 18,000 barrels of water will be used to drill and complete both wells. The primary water source will be a spring in 27S 70W S 22, which is approved by the state as an industrial source. Weber drilling is a commercial water transport and supply service who could provide additional water, as well as the Huerfano River, which Oxy has secured approval for drilling use for this project. Oxy has reached an agreement with the Huerfano County Water Conservancy District, and is covered under their Substitute Water Supply plan for the use of the spring and river sources. Water rights and their use is regulated by the state of Colorado. The operator will comply with all state regulations pertaining to water use.

Surface water impacts of the proposed wells are mainly associated with the surface disturbance associated with drilling and related infrastructure after well completion. For all proposed development, 8 acres would be temporarily disturbed with 3 acres long term. Much of this disturbance would be located on an existing well pad that is already heavily disturbed. Most impacts to surface water from oil and gas activity is due to removal of vegetation and exposure of mineral soils. Specific impacts would be soil compaction caused by construction that would reduce the soil infiltration rates, in turn increasing runoff during precipitation events. Downstream effects of the increased runoff may include changes in downstream channel morphology such as bed and bank erosion or accretion. Due to the, previous disturbance, flat nature of the topography and infiltration rates of the soils in this area, state required stormwater controls, little to no new impacts to surface water quality would result from the surface disturbance portion of drilling the proposed wells. Additional surface water impacts could result from chemicals, or other fluids, accidentally spilled or leaked during the development process and could result in the contamination of both ground and surface waters. Federal and state regulations require cleanup of all accidental spills, which would mitigate this potential issue.

The drilling of the proposed wells would pass through usable groundwater. Groundwater in this area is relied on for agricultural uses, as well as, domestic use. Potential impacts to groundwater resources could occur if proper cementing and casing programs are not followed. This could include loss of well integrity, surface spills, or loss of fluids in the drilling and completion process. It is possible for chemical additives used in drilling activities to be introduced into the water producing formations without proper casing and cementing of the well bore. Changes in porosity or other properties of the rock being drilled through can also result in the loss of drilling

fluids. When this occurs, drilling fluids can be introduced into groundwater without proper cementing and casing. Site specific conditions and drilling practices determine the probability of this occurrence and determine the groundwater resources that could be impacted. In addition to changing the producing formations' physical properties by increasing the flow of water, gas, and/or oil around the well bore; hydraulic fracturing can also introduce chemical additives into the producing formations. Types of chemical additives used in drilling activities may include acids, hydrocarbons, thickening agents, lubricants, and other additives that are operator and location specific. These additives are not always used in these drilling activities and some are likely to be benign such as bentonite clay and sand. Concentrations of these additives also vary considerably since different mixtures can be used for different purposes in oil and gas development and even in the same well bore. If contamination of aquifers from any source occurs, changes in groundwater quality could impact springs and water wells that are sourced from the affected aquifers. Onshore Order #2 requires that the proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones.

At this stage, geologic and engineering reviews have been done to ensure that cementing and casing programs are adequate to protect all downhole resources. Known water bearing zones in the APD area are protected by drilling requirements and, with proper practices, contamination of ground water resources is highly unlikely. Casing along with cement would be extended well beyond fresh-water zones to insure that drilling fluids remain within the well bore and do not enter groundwater.

Protective/Mitigation Measures:

No additional mitigation is required to protect water resources beyond what is found in other sections of this document, federal and state regulations, and other APD approval requirements.

Cumulative Impacts: None

No Action Alternative:

Direct and Indirect Impacts: None

3.3. Biological Resources

3.3.1. Invasive Plants*

Affected Environment: Noxious weeds within 10 miles of project location include but are not limited too: Scotch thistle, Canada thistle, leafy spurge, and Russian knapweed. The project location has seen long-term exposure to livestock grazing, but has not been severely impacted due to topography. Project location is located in a high density pinion juniper stand and is adjacent to an existing gas well site. OXY regularly treats noxious weeds on their service roads and around existing wells.

Environmental Effects

Proposed Action:

Direct and Indirect Impacts: Due to regular treatment of noxious weeds in project area by OXY and reclamation identified in section 2.2, expected impacts are thought to be minor.

Protective/Mitigation Measures: Equipment used to implement the proposed action should be washed prior to entering the project area to remove any plant materials, soil, or grease. Areas disturbed by project implementation should be monitored for the presence of weeds on the Colorado State Noxious Weed list. Identified noxious weeds should be treated. Monitoring should be for the life of the project and for three years following completion and/or abandonment of the wells and elimination of identified Colorado State Noxious Weeds list A and B species. Also see reclamation in section 2.2.

Cumulative Impacts: None.

No Action Alternative:

Direct and Indirect Impacts: None

Protective/Mitigation Measures: None

*Invasive plants are plants that are not part of (if exotic), or are a minor component of (if native), the original plant community or communities that have the potential to become a dominant or co-dominant species on the site if their future establishment and growth are not actively controlled by management interventions, or are classified as exotic or noxious plants under state or federal law. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants.

3.3.3. Vegetation

Affected Environment: This area supports grassland, shrub-grassland, and forestland vegetation. Pinyon pine, juniper, true mountain mahogany, blue grama, needleandthread, and wheatgrasses are common. Project location is located in a high density pinion juniper stand and is adjacent to an existing gas well site. OXY regularly treats noxious weeds on their service roads and around existing wells.

Environmental Effects

Proposed Action:

Direct and Indirect Impacts: Generally oil and gas development involves complete removal of vegetation and at times re-contouring of the landscape to allow for resources to be retrieved. The type of ground activity associated with oil and gas development does result in increased susceptibility to adverse impacts such as soil compaction, weed infestations and erosion (See Soils and Invasive Plants sections). Due to these adverse impacts, establishment of native vegetation similar to adjacent undisturbed vegetation can take up to 30 years.

Protective/Mitigation Measures: See reclamation in section 2.2.

Cumulative Impacts: The removal of vegetation necessary for the construction of the pad will result in a minor decrease in native vegetation in the project area,

however much of the vegetation in the general project area is already highly modified for agricultural uses and CO_2 production.

No Action Alternative:

Direct and Indirect Impacts: None

Protective/Mitigation Measures: None

3.3.4. Wildlife Terrestrial

Affected Environment: The Sheep Mountain CO_2 Field was developed between 1981 and 1985. The infrastructure (roads, pipelines pads, facilities, etc.) needed to facilitate the minor expansion project proposed were installed at that time and have been active for more than 30 years. The area consists of a conifer habitat type containing Douglas-fir, and ponderosa pine. The understory is usually sparse in this type and is dominated by Arizona fescue. The project area is a well-known elk production area and provides severe winter range for both elk and mule deer. Other big game animals common to the area include mountain lion and black bear although use by these species is dispersed and sporadic.

Environmental Effects

Proposed Action:

Direct and Indirect Impacts: The Proposed Action would authorize the expansion of the well pad and the drilling of two additional wells. The immediate impact is the expansion of well pad by eight acres at the construction phase, then reduced to three acres after interim reclamation. The long term impacts of the additional wells will be negligible because the existing setting for terrestrial wildlife will not be altered. Impacts to wildlife would derive from the increase in human activity during the drilling phase, causing an increase in stress to wildlife and disturbing movement patterns throughout the impact area.

Protective/Mitigation Measures: A timing limitation restricting development activity will be in place from January 1 to March 1 to reduce impact to wintering big game animals (mule deer and elk). An exception may be granted if climatic conditions warrant.

Cumulative Impacts: None

No Action Alternative:

Direct and Indirect Impacts: Under the No Action alternative, no ground disturbing activities would occur resulting in no impact to terrestrial wildlife species.

Protective/Mitigation Measures: None.

3.3.5. Migratory Birds

Affected Environment: The Migratory Bird Treaty Act (MBTA) includes guidance for the protection of native passerines (songbirds) as well as birds of prey, migratory waterbirds (waterfowl, wading birds, and shorebirds), and other species such as doves, hummingbirds, swifts,

and woodpeckers. Within the context of the MBTA, "migratory" birds include non-migratory "resident" species as well as true migrants, essentially encompassing most native bird species. The nesting time period is of special importance as the ability to create a nest, incubate, and rear chicks to fledging is a vulnerable time period for birds, and disturbances to nesting activities can lead to larger consequences for individual birds. In addition, because birds are generally territorial during the nesting season, their ability to access and utilize sufficient food is limited by the quality and availability of the territory occupied. During non-breeding seasons, birds are generally non-territorial and able to feed across a larger area and wider range of habitats.

The Proposed Action would authorize the drilling of an additional well and deepening an existing well on an existing pad. The immediate impact is the temporary expansion of well pads the act of drilling two new wells. The long term impacts of the additional wells will be negligible because the existing setting for terrestrial wildlife will not be altered. Impacts to wildlife would derive from the increase in human activity during the drilling phase, causing an increase in stress to wildlife and disturbing movement patterns throughout the impact area.

Ponderosa pine, mixed conifer and mountain shrubland habitats are found at higher elevations in the project area. In Fremont County these sites are very dry and warm areas, with less than 25 inches of precipitation annually. Mature ponderosa pine forests on dry sites are open, with mature trees achieving wide separation as they compete for limited soil moisture. Grassy ground cover is maintained by frequent low-intensity fires. Ponderosa pines are the largest conifers in Colorado and Gambel oak is a common component of the understory, typically in a shrubby form. Other common understory shrubs include mountain mahogany and wax currant. Tree species sometimes found mixed with ponderosa pine are junipers, pinyon pine, aspen, white fir, and Douglas-fir. Birds typical of these habitat types include Merriam's turkey, Williamson's sapsucker, pygmy nuthatch, western bluebird, band-tailed pigeon, Grace's warbler, flammulated owl, red-breasted nuthatch, violet-green swallow, western tanager, and chipping sparrow. These sites also include small areas of aspen habitat and mountain grassland habitat.

Species that could occur within the project area that are listed on the Birds of Conservation Concern list for the Southern Rockies/Colorado Plateau region include: pinyon jay, ferruginous hawk, Lewis's woodpecker, gray vireo, juniper titmouse, Grace's warbler, golden eagle, and Cassin's finch.

Environmental Effects

Proposed Action:

Direct and Indirect Impacts: Surface disturbing activities associated with implementation of the Proposed Action could impact nesting species if conducted during the nesting season. Noise generated during construction, drilling, and production phases will likely result in a larger impact footprint (i.e. avoidance of human activity) then the disturbance footprint alone.

Protective/Mitigation Measures: To be in compliance with the Migratory Bird Treaty Act (MBTA) and the Memorandum of Understanding between BLM and USFWS required by Executive Order 13186, BLM must avoid actions, where possible, that result in a "take" of migratory birds. Under the MBTA, "take" means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. All mortality or injury to species protected by the MBTA shall be reported immediately to the BLM project lead and to the USFWS representative.

Pursuant to BLM Instruction Memorandum 2008-050, to reduce impacts to Birds of Conservation Concern (BCC), no habitat disturbance (removal of vegetation such as timber, brush, or grass) is allowed during the periods of May 15 - July 15, during the breeding and brood rearing season for most Colorado migratory birds. An exception to this TL will be granted if nesting surveys conducted no more than one week prior to surface-disturbing activities indicate no nesting within 30 meters (100 feet) of the area to be disturbed. Surveys shall be conducted by a qualified breeding bird surveyor between sunrise and 10:00 a.m. under favorable conditions. This provision does not apply to ongoing construction, drilling, or completion activities that are initiated prior to May 15 and continue into the 60-day period.

Any secondary containment system will be covered in a manner to prevent access by migratory birds. The operator will construct, modify, equip, and maintain all open-vent exhaust stacks on production equipment to prevent birds and bats from entering, and to discourage perching, roosting, and nesting. Production equipment includes, but may not be limited to, tanks, heater-treaters, separators, dehydrators, flare stacks, and in-line units. Any action that may result in a "take" of individual migratory birds or nests that are protected by MBTA will not be allowed.

Cumulative Impacts: None

No Action Alternative:

Direct and Indirect Impacts: Under the No Action alternative, no ground disturbing activities would occur resulting in no impact to migratory birds.

Protective/Mitigation Measures: None.

3.4. Heritage Resources and Human Environment

3.4.1. Wastes, Hazardous or Solid

Affected Environment:

It is assumed that conditions associated with the proposed project site, both surface and subsurface, are currently clean and that there is no known contamination. A determination will be made by the operator prior to initiating the project, if there is evidence that demonstrates otherwise (such as solid or hazardous wastes have been previously used, stored, or disposed of at the project site).

Nothing in the analysis or approval of this action by BLM authorizes or in any way permits a release or threat of a release of hazardous materials (as defined under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations) into the environment that will require a response action or result in the incurrence of response costs.

Environmental Effects

Proposed Action:

Direct and Indirect Impacts:

Possible contaminant sources associated with the drilling operations are: Storage, use and transfer of petroleum, oil and lubricants, produced fluids, general hazardous substances, chemicals and/or wastes, concrete washout water drilling water, mud and cuttings.

Protective/Mitigation Measures:

The following mitigation will assist in reducing potential spills resulting in groundwater and/or soil contamination:

• All Above Ground Storage Tanks will need to have secondary containment and constructed in accordance with standard industry practices or an associated Spill Prevention Control and Countermeasures plan in accordance with State regulations (if applicable).

• If drums are used, secondary containment constructed in accordance with standard industry practices or governing regulations is required. Storage and labeling of drums should be in accordance with recommendations on associated MSDS sheets, to account for chemical characteristics and compatibility. • Appropriate level of spill kits need to be onsite and in vehicles.

• All spill reporting needs to follow the reporting requirements outlined in NTL-3A.

• All concrete washout water needs to be contained and properly disposed of at a permitted offsite disposal facility.

Cumulative Impacts: None

No Action Alternative:

Direct and Indirect Impacts: None

Protective/Mitigation Measures: None

3.5. Cumulative Impact Summary

The proposed project is located in Huerfano County, Colorado. Huerfano County's economy is based primarily on ranching and hay farming. Due to this, much of the natural landscape of Huerfano County has been modified. Huerfano County has approximately 46 active oil or gas wells. Most of these wells are located on privately owned surface and produce entirely privately owned minerals. Because of the comparatively small number of federally owned mineral parcels in this area, the cumulative impact of the drilling and operation of these two CO_2 wells would add incrementally to the cumulative impacts of oil and gas development in Huerfano County. These include minor impacts to air, fluid minerals (geology), soils and vegetation and soils.

Air: The area currently has a high degree of alteration in the form of agricultural fields and roads. The addition of the infrastructure needed to construct and drill the additional proposed wells would have a minimal cumulative impact to the area's air quality given the location of the proposed action and the total cumulative emissions level for the area.

Geology: Cumulative impacts on geology and fluid minerals resources would primarily occur as a result of development, which would irreversibly deplete recoverable carbon dioxide from the producing formations.

Soils: Construction of the pad extension would result in minor, temporary destabilization of soils in the project area, until the soils are recontoured and revegetated at interim and final reclamation stages. This may result in a slight loss of some topsoil due to wind and water erosion.

Vegetation: The removal of vegetation necessary for the construction of the pad will result in a minor decrease in native vegetation in the project area, however much of the vegetation in the general project area is already highly modified for agricultural uses and CO_2 production.

Chapter 4 Consultation and Coordination

4.1. List of Preparers and Participants

Please see Interdisciplinary Team Review list for BLM Participants.

4.2. Tribes, Individuals, Organizations or Agencies Consulted

Tribes were consulted at the lease stage.

Chapter 5. References

Bureau of Land Management. 1986. Northeast Resource Area Management Plan and Record of Decision. Lakewood, Colorado.

Bureau of Land Management. 1991. Colorado Oil and Gas Leasing Environmental Impact Statement. Lakewood, Colorado.

Bureau of Land Management. 2008 H-1790-1 National Environmental Policy Handbook. Washington, D.C.