United States Department of the Interior
Bureau of Land Management

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Cluster 20

Lybrook E13-2306

NMNM 18946 & NMNM 23231

Lybrook I14-2306

Lease Number NMNM 118127

Gallo Canyon Unit M14-2306

Lease Number NMNM 17009

Gallo Canyon Unit M15-2306

Lease Number NMNM 17009

Gallo Canyon Unit O15-2306

Lease Number NMNM 17009

Gallo Canyon Unit P14-2306

Lease Number NMNM 17009

Gallo Canyon Unit North Access Road

Gallo Canyon Unit North Trunk Pipeline

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

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ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
APD	Application for Permit to Drill
AQI	Air Quality Index
AUM	animal unit month
bbl	barrel
BLM	Bureau of Land Management
BOP	blowout preventer
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
CO	carbon monoxide
CO_2	carbon dioxide

CO_2e	carbon dioxide equivalent
COA	Conditions of Approval
EA	Environmental Assessment
Ecosphere	Ecosphere Environmental Services, Inc.
EIS	Environmental Impact Statement
Encana	Encana Oil & Gas (USA) Inc.
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FFO	Farmington Field Office
GHG	greenhouse gases
HAP	hazardous air pollutants
LAC	La Plata Archaeological Consultants
MLA	Mineral Leasing Act
NAAQS	National Ambient Air Quality Standard
NATA	National Scale Air Toxics Assessments
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NMAAQS	New Mexico Ambient Air Quality Standards
NMPIF	New Mexico Partners in Flight
NMSA	New Mexico Statutes Amended
NO_2	nitrogen dioxide
NO_x	nitrous oxides
O_3	ozone
Pb	lead
PL	Public Law
PM_{10}	particulate matter between 2.5 and 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PRMP	Proposed Resource Management Plan
RFDS	reasonably foreseeable development scenario
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
SDA	Specially Designated Area
SO_2	sulfur dioxide
TUA	temporary use area
USC	United States Code
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USEPA	United States Environmental Protection Agency

USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	volatile organic compounds

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1. PURPOSE AND NEED FOR ACTION

1.1 Background

Encana Oil & Gas (USA) Inc. (Encana) is proposing to develop the Lybrook E13-2306, Lybrook I14-2306, Gallo Canyon Unit M14-2306, Gallo Canyon Unit M15-2306, Gallo Canyon Unit O15-2306, and Gallo Canyon Unit P14-2306 well pads, along with the Gallo Canyon Unit North Access Road and the Gallo Canyon Unit North Trunk pipeline (Cluster 20) in Rio Arriba and Sandoval Counties, New Mexico. Encana has filed Applications for Permit to Drill (APDs) with the United States Department of Interior (USDI) Bureau of Land Management (BLM) Farmington Field Office (FFO) to drill the wells listed in Table 1-1.

Table 1-1. Number of wells drilled per pad under the proposed action

No. of Wells	Well Number	Well Pad
1	01H	Gallo Canyon Unit M14-2306
2	01H, 02H	Lybrook E13-2306 Gallo Canyon Unit M15-2306 Gallo Canyon Unite O15-2306
3	01H, 02H, 03H	Gallo Canyon Unit P14-2306
4	01H, 02H, 03H, 04H	Lybrook I14-2306

The Lybrook I14-2306 well pad would be located on lease, and the pad and access road would be permitted through the APD process; the well-tie pipeline would be permitted by a right-of-way (ROW) grant. Encana has also applied for ROW grants with the BLM/FFO to construct the Lybrook E13-2306, Gallo Canyon Unit M14-2306, Gallo Canyon Unit M15-2306, Gallo Canyon Unit O15-2306, and Gallo Canyon Unit P14-2306 well pads, access roads, and pipelines. The Gallo Canyon Unit North Access Road and Trunk pipeline would also be permitted by ROW grants with the BLM/FFO. A portion of the proposed Gallo Canyon Unit North Trunk pipeline would be permitted through an Off-site Business Lease with the New Mexico State Land Office.

Surface disturbance activities associated with drilling the wells would include construction of six well pads, new and upgraded access roads, subsurface well-tie pipelines, and a trunk pipeline. The proposed action would be located on BLM-managed and State-managed land and would access federal minerals administered by the BLM/FFO. The proposed action would be located approximately 0.65 mile north of Counselor, New Mexico.

1.2 Purpose and Need for Action

The purpose of the proposed action is to provide Encana with reasonable access to BLM-managed federal mineral leases (NMNM 18946, NMNM 23231, NMNM 118127, and NMNM 17009) to construct the six proposed wells pad, access roads, well-tie and trunk pipelines, and drill the 10 proposed wells. The need for the action is BLM's responsibility under the Mineral Leasing Act (MLA) of 1920, as amended (30 United States Code [USC] 181 et seq.), to respond to the APDs and ROW applications. The MLA authorizes the BLM to issue oil and gas leases for the exploration of mineral resources and permit

the development of those leases. The need for the action is also established by the BLM's authority under the Title V of the Federal Land Policy and Management Act, as amended (43 USC 1761-1771), and Section 28 of the MLA (43 USC 185).

1.3 Decision to be Made

Based on the information in this Environmental Assessment (EA), the BLM/FFO will decide whether to approve the APDs and ROW grants, and if so, under what terms and conditions. In compliance with the MLA, the decision to be made is how resource development should occur. Under the National Environmental Policy Act (NEPA), as amended (Public Law [PL]. 91-90, 42 USC 4321 et seq.), the BLM/FFO must determine if there are any significant environmental impacts associated with the proposed action, warranting further analysis in an Environmental Impact Statement (EIS). The BLM/FFO Field Manager is the responsible officer who will decide one of the following:

- To approve the proposed APDs and ROW grants with design features as submitted
- To approve the proposed APDs and ROW grants with additional mitigations
- To analyze the effects of the proposal in an EIS
- To deny the APDs and ROW grants

1.4 Conformance with Applicable Land Use Plan(s)

Pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21, this EA incorporates the information and analysis contained in the 2003 Farmington Proposed Resource Management Plan (PRMP)/Final Environmental Impact Statement (FEIS) (USDI/BLM 2003a). The proposed action would be in conformance with the oil and gas leasing and development management actions in the Resource Management Plan (RMP)/Record of Decision (ROD) signed December 2003 and updated in December 2003 (USDI/BLM 2003b). The proposed action would be in conformance with the 2003 RMP/ROD that states, to the extent possible, new ROWs would be located within or parallel to existing ROWs or corridors to minimize resource impacts (USDI/BLM 2003b, page 2-11).

The PRMP/FEIS and ROD are available for review at the FFO in Farmington, New Mexico, or electronically at http://www.nm.blm.gov/ffo/ffo_home.html. This project EA addresses site-specific resources and/or impacts that are not covered within the PRMP/FEIS, as required by the NEPA.

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Oil and gas development is recognized as an appropriate use of public lands in the FFO planning area (USDI/BLM 2003b). The RMP adheres to the federal mandates contained in the Energy Policy and Conservation Action (42 USC 6217) and Executive Order 13212, that direct federal land managing agencies to expedite the production of the federal mineral estate for the development of reliable domestic sources of energy (USDI/BLM 2003b, pages 1 and 11). The proposed project would not be in conflict with any local, county, or state plans.

1.5 Relationship to Statutes, Regulations, or Other Plans

Encana would comply with all applicable federal, state, and local laws and regulations, as well as obtain the necessary permits for the installation and operation of the pipeline. These laws and regulations include, but are not limited to:

- Antiquities Act of 1906, as amended (PL 52-209; 16 USC 431-433)
- American Indian Religious Freedom Act of 1978 (PL 95-431; 92 Stat. 469; 42 USC 1996)
- Archaeological Resources Protection Act of 1979 (PL 96-95; 93 Stat. 721; 16 USC § 470aa et seq.), as amended (PL 100-555; PL 100-588)
- Bald and Golden Eagle Protection Act of 1940, as amended (PL 86-70, PL 87-884, PL 92-535, PL 95-616; USC 668-668d)
- Clean Air Act, as amended (PL 88-206; 42 USC § 7401 et seq.)
- Clean Water Act, as amended (PL 107-303; 33 USC § 1251, et seq.)
- Colorado River Salinity Control Act, as amended (PL 93-320; 7 CFR Part 702)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (PL 96-510; 42 USC § 9601; 40 CFR Part 307)
- Endangered Plant Species Act (New Mexico Statutes Amended [NMSA] 1978 § 75-6-1)
- Endangered Species Act of 1973 (PL 93-205; 16 USC § 1531 et seq.)
- Executive Order 11988 Floodplain Management
- Executive Order 11990 Protection of Wetlands
- Executive Order 12898 Environmental Justice
- Executive Order 13007 Indian Sacred Sites
- Executive Order 13112 Invasive Species
- Executive Order 13186 Responsibilities of Federal Agencies to Protect Migratory Birds
- Migratory Bird Treaty Act of 1918, as amended (16 USC §§ 703-712; 50 CFR Part 21)
- Native American Graves Protection and Repatriation Act of 1990 (PL 101-601; 104 Stat. 3048; 25 USC 3001; 43 CFR Part 10)
- New Mexico Oil and Gas Act (NMSA 1978 § 70-2-1–38) and related statutory provisions
- Paleontological Resources Preservation Act as part of the Omnibus Public Land Management Act (PL 111-011, Title VI, Subtitle D)
- Safe Drinking Water Act, as amended (PL 93-523; 42 USC 300F-300-9), 40 CFR Parts 144 and 147)
- Section 106 of the National Historic Preservation Act of 1966 (PL 89-665; 80 Stat. 915; 16 USC 470 et seq.), as amended (implemented under regulations of the Advisory Council on Historic Preservation, 36 CFR Part 800)
- Wildlife Conservation Act (NMSA 1978 § 17-2-37 et seq.)

1.6 Scoping, Public Involvement, and Issues

The Council on Environmental Quality (CEQ) defines scoping as "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action alternative" (40 CFR 1501.7). Scoping is the process by which the BLM solicits internal and external input on the issues, impacts, and potential alternatives that will be addressed in an EIS or EA. As outlined in the BLM NEPA Handbook, it is optional for the BLM to conduct external scoping on actions analyzed by an EA (USDI/BLM 2008a, Section 6.3.2).

The BLM/FFO Interdisciplinary Team was integrally involved in the internal scoping to identify potential issues, understand the proposal, develop the purpose and need, and develop a range of alternatives.

For the purpose of BLM NEPA analysis, an "issue" is a point of disagreement, debate, or dispute with a proposed action based on some anticipated environmental effect. Preliminary issues are frequently identified during the development of the proposed action through scoping.

The following issues were identified as potential issues of concern by the Interdisciplinary Team during internal scoping:

- How would the proposed action affect air quality in the area?
- How would the proposed action affect water resources?
- How would the proposed action affect soil resources?
- How would the proposed action affect upland vegetation and noxious weeds?
- How would the proposed action affect wildlife, BLM special management species, and migratory birds?
- How would the proposed action affect cultural resources and traditional cultural properties?
- How would the proposed action affect livestock grazing?

As outlined in the BLM NEPA Handbook, it is optional for the BLM to conduct external scoping on actions analyzed by an EA (USDI/BLM 2008a, Section 6.3.2). External scoping was conducted through posting this project on the BLM/FFO's online NEPA log. The log is located on the BLM New Mexico website (http://www.blm.gov/nm/st/en/prog/planning/nepa_logs.html). The log contains a list of proposed and approved actions in the FFO. The public is encouraged to provide comments or request information on projects listed in the logs.

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1.6.1 Issues Considered but Not Analyzed

CEQ regulations (40 CFR § 1501.7) state that the lead agency shall identify and eliminate from detailed study the issues that are not important or that have been covered by prior environmental review, narrowing the discussion of these issues in the document to a brief presentation of why they would not have a significant effect on the human or natural environment or providing a reference to their coverage elsewhere.

The Interdisciplinary Team identified the following resources during internal scoping as a potential issue of concern that would not be significantly impacted.

No federally listed species with the potential to occur in Rio Arriba or Sandoval Counties or potential habitats for federally listed species were observed within the proposed analysis area. Furthermore, no designated critical habitat for any federally listed species occurs within the proposed analysis area. Water used for well drilling and completions would be sourced from a permitted private water well (Point of Diversion Number SJ 01979-S4). No new water depletions would result from the proposed action. The BLM/FFO reviewed and determined that the proposed action is in compliance with listed species management guidelines outlined in the September 2002 Biological Assessment (Cons. No. 2-22-01-I-389) (USDI/BLM 2002). No further consultation with the U.S. Fish and Wildlife Service (USFWS) is required.

2. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

Encana is proposing development of the Cluster 20 well pads, well tie pipelines, and roads to access the mineral estate administered by the BLM/FFO. The action would also include the Gallo Canyon Unit North Access Road and Gallo Canyon Unit North Trunk pipeline. The proposed action would be located in Rio Arriba and Sandoval Counties, New Mexico approximately 0.65 mile north of Counselor. A vicinity map is provided as Figure 1 in Appendix A. Figure 2 shows the proposed action on the Counselor, New Mexico U.S. Geological Survey (USGS) 7.5-minute topographic map. Figure 3 displays the proposed action on the Counselor, New Mexico 2010 digital photo orthoquad (see Appendix A). Photographs of the proposed action components are also provided in Appendix A. Legal descriptions of the proposed action components are listed in Table 2-1.

Table 2-1. Legal description for the proposed action components surface location

Component		Legal Description
Lybrook E13-2306	Well pad	NW ¼ of Section 13, Township 23 North, Range 6 West
	Access road and pipeline	Sections 13, 14, and 15, Township 23 North, Range 6 West
Lybrook I14-2306	Well pad	SE ¼ of Section 14, Township 23 North, Range 6 West
	Access road and pipeline	Section 14, Township 23 North, Range 6 West
Gallo Canyon Unit M14-2306	Well pad	SW ¼ of Section 14 and NW ¼ Section 23, Township 23 North, Range 6 West
	Access road and pipeline	Section 14, Township 23 North, Range 6 West
Gallo Canyon Unit M15-2306	Well pad	SW ¼ of Section 15 and NW ¼ of Section 22, Township 23 North, Range 6 West
	Access road and pipeline	Section 15, Township 23 North, Range 6 West
Gallo Canyon Unit O15-2306	Well pad	SE ¼ of Section 15, Township 23 North, Range 6 West
	Access road and pipeline	Section 15, Township 23 North, Range 6 West
Gallo Canyon Unit P14-2306	Well pad	SE ¼ of Section 14, NE ¼ Section 23, Township 23 North, Range 6 West
	Access road and pipeline	Section 14, Township 23 North, Range 6 West
Gallo Canyon Unit North Access Road		Sections 14 and 15, Township 23 North, Range 6 West
Gallo Canyon Unit North Trunk Pipeline		Sections 9, 15, and 16, Township 23 North, Range 6 West

Note: NE = northeast; NW = northwest; SE = southeast; SW = southwest

Construction of the proposed action would require temporary use areas (TUA). Table 2-2 lists the TUA locations, purpose, and legal descriptions.

Table 2-2. Temporary use area locations and legal description

Component	Station	Purpose	Legal Description
Lybrook E13-2306 well-tie pipeline	24+55 to 26+87	Wash crossing	NE ¼ SE ¼ Section 14, Township 23 North, Range 6 West
	43+07 to 45+57	Wash crossing	SW ¼ Section 15, Township 23 North, Range 6 West
Lybrook E13-2306 access road	8+79 to 11+39	Hilltop construction	E ½ of Section 14, Township 23 North, Range 6 West
	29+65 to 32+15	Wash crossing	E ½ of Section 14, Township 23 North, Range 6 West
Lybrook M14-2306 well tie pipeline	1+65 to 4+60	Wash crossing	W ½ of SE ¼ Section 14, Township 23 North, Range 6 West
Gallo Canyon Unit North Access Road	76+52 to 78+48	Armor drainage and install silt traps	NW ¼ SW ¼ Section 14, Township 23 North, Range 6 West
	88+03 to 89+13	Armor Wash	NE ¼ SW ¼ Section 14, Township 23 North, Range 6 West
Gallo Canyon Unit North Trunk Pipeline	48+60 to 48+85	Road bore	SW ¼ NW ¼ Section 15, Township 23 North Range 6 West

Note: NE = northeast; NW = northwest; SE = southeast; SW = southwest; E = east

Table 2-3 lists the well-tie pipeline and access road lengths and the dimensions of the well pads and TUAs that would be permitted by ROW grants from the BLM/FFO. The Lybrook I14-2306 well pad would be on lease and would be permitted through the APD process. The table includes land status for each project component.

Table 2-3. Permitted rights-of-way per land status for the proposed action

Name	Type of Right-of-Way[1]	Bureau of Land Management (feet)	State of New Mexico (feet)
Lybrook E13-2306	Well pad	400 x 430	
	Access road	96	
	Pipeline	12,907	
	Temporary use areas	230 x 80 250 x 80 Irregular 250 x 80	
Lybrook I14-2306 (on lease)	Pipeline	773	
Gallo Canyon Unit M14-2306	Well pad	400 x 400	
	Access road	378	
	Pipeline	2,245	
	Temporary use area	125 x 282	
Gallo Canyon Unit M15-2306	Well pad	400 x 400	

Name	Type of Right-of-Way[1]	Bureau of Land Management (feet)	State of New Mexico (feet)
	Access road	435	
	Pipeline	519	
Gallo Canyon Unit O15-2306	Well pad	400 x 430	
	Access road	968	
	Pipeline	990	
Gallo Canyon Unit P14-2306	Well pad	400 x 460	
	Access road	2,243	
	Pipeline	1,561	
Gallo Canyon Unit North Access Road[2]	Road	9,460	
	Temporary use area	Irregular shape Irregular shape	
Gallo Canyon Unit North Trunk Pipeline	Pipeline	10,429	85
	Temporary use area	30 x 80	

[1] On lease well pad and road would be permitted through the Application for Permit to Drill process

[2] Permitted with a 40-foot-wide right-of-way

Activities associated with the proposed project would include construction of the access roads and well pads; upgrading existing roads; drilling, stimulation, and completion of the proposed wells; installation of surface facilities necessary to produce the wells; and installation of pipelines to transport natural gas to markets. These activities are detailed below.

Construction

Construction for the access roads and well pads would take approximately 1 to 2 weeks per location. Table 2-4 provides a summary of proposed disturbance that would occur under the proposed action. Detailed descriptions are provided in the following paragraphs. The Gallo Canyon Unit North Access Road is discussed with the Lybrook E13-2306 because would be used to access the well pad, and it parallels and overlaps disturbance from the Lybrook E13-2306 well tie pipeline.

Table 2-4. Summary of surface disturbance for the proposed action

	Short Term Disturbance (acres)			New Disturbance (acres)	Long Term Disturbance (acres)		
Name	**Well Pad**	**Pipeline/ Road[1]**	**Total**	**Total**	**Well Pad**	**Pipeline/ Road[1]**	**Total**
Lybrook E13-2306 and Gallo Canyon Unit North Access Road[2]	6.08	22.3	28.4	18.8	1.6	8.0	9.6
Lybrook I14-2306	7.12	1.0	8.1	7.8	1.6	0.4	2.0
Gallo Canyon Unit M14-2306	5.74	3.1	8.8	8.8	1.6	0.3	1.9
Gallo Canyon Unit M15-2306	5.74	0.6	6.3	6.3	1.6	0.2	1.8
Gallo Canyon Unit O15-2306	6.08	1.2	7.3	7.2	1.6	0.4	2.0
Gallo Canyon Unit P14-2306	6.43	2.4	8.8	8.8	1.6	1.1	2.7
Gallo Canyon Unit North Trunk Pipeline	n/a	9.8	9.8	4.9	n/a	0	0
TOTAL			**77.5**	**62.6**			**20.0**

[1] Where pipeline and roads parallel the construction corridor is 50 feet wide; for access roads, the construction corridor is 30 feet wide; for pipelines on Bureau of Land Management (BLM) managed land, the construction corridor is 40 feet wide, and for pipelines of state-managed lands the construction corridor is 30 feet wide, unless otherwise noted in text below.

[2] Disturbance associated with these project components is shown together because the Gallo Canyon Unit North Access Road parallels and overlaps disturbance from the Lybrook E13-2306 well tie pipeline for a large proportion of its length.

Drilling of the proposed Lybrook E13-2306 wells would require constructing a 400-foot by 430-foot well pad with a 50-foot-wide construction zone around the perimeter of the pad, for a total disturbance of 6.08 acres. Maximum cut would be approximately 7.3 feet at corner 2, and the maximum fill would be approximately 4.8 feet at corner 5. To access the pad, Encana would construct the Gallo Canyon Unit North Access Road, the Lybrook E13-2306 access road, and upgrade an existing road. The Gallo Canyon Unit North Access Road would be approximately 9,460 feet in length and would connect to an approximately 3,456 foot section of existing road, which would be upgraded and would connect to the proposed Lybrook E13-2306 access road that would be approximately 96 feet in length. The proposed Gallo Canyon Unit North Access Road would parallel existing disturbance for its entire length and would be permitted by a 40-foot-wide ROW. The Gallo Canyon Unit North Access Road would be a collector road with a 24-foot-wide travelway. The Lybrook E13-2306 upgraded access road would be a resource road with a 14-foot-wide travelway. The Lybrook E13-2306 new access road would be constructed within the proposed well pad and construction zone disturbance. There would 46 feet of new access that would not overlap the well pad disturbance. Ten 24-inch culverts would be installed along the Gallo Canyon Unit North Access Road. Nine 24-inch culverts would be installed along the proposed Lybrook E13-2306 upgraded access road. Three turnouts would be constructed along the upgraded access road. Each turnout would be approximately 150 feet long and 10 to 20 feet wide, resulting in a total of

approximately 0.15 acre of disturbance. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 12,907 feet in length. Approximately 4,469 feet of the North Gallo Canyon Unit Access Road and 1,001 feet of the upgraded access would not be parallel to the proposed pipeline. The proposed pipeline would parallel the Gallo Canyon Unit North Access Road for approximately 4,991 feet. Where the pipeline and Gallo Canyon Unit North Access Road are parallel, the construction corridor would be 60 feet wide. The proposed pipeline would parallel the Lybrook E13-2306 upgraded access road for approximately 2,359 feet requiring a 50-foot-wide construction corridor. The remaining sections of the pipeline would be constructed within a 40-foot-wide ROW. The proposed pipeline and access would result in 19.8 acres of disturbance. Total surface disturbance of the proposed project, including the 6 TUAs, would be approximately 28.4 acres. After interim reclamation, 9.6 acres (1.6 acres for the well pad and 8.0 acres for the access) would remain in use for well operation.

Drilling of the proposed Lybrook I14-2306 wells would require constructing a 400-foot by 520-foot well pad with a 50-foot-wide construction zone around the perimeter of the pad, for a total disturbance of 7.12 acres. Maximum cut would be approximately 21 feet at corner 2 and the maximum fill would be approximately 16.1 feet at corner 5. To access the pad, an approximately 782-foot road would be constructed. Encana would also construct and operate a well-tie pipeline, which would be approximately 773 feet in length. The proposed access road would parallel the proposed pipeline. Total construction width of the pipeline/access road would be 50 feet and would be designated as 30 feet of disturbance for the road and 20 feet of disturbance adjacent to the road for the pipeline. The remaining 9 feet of the access would be constructed within a 30-foot-wide corridor. Four 24-inch culverts would be installed within the disturbance from the access road. There would be one turnout constructed adjacent to the access road. The proposed road with the pipeline would result in 1 acre of disturbance. Total surface disturbance of the proposed project would be approximately 8.1 acres. After interim reclamation, 2.0 acres (1.6 acres associated with the well pad and 0.4 acre for the access road) would remain in use for operation.

Drilling of the proposed Gallo Canyon Unit M14-2306 01H well would require constructing a 400-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter of the pad, for a total disturbance of 5.74 acres. Maximum cut would be approximately 9.9 feet at corner 6, and the maximum fill would be approximately 7.2 feet at corner 3. To access the pad, an approximate 378-foot road would be constructed, and 2,650 feet of existing road would be upgraded. The existing road is in good condition, and upgrading it would not contribute to surface disturbance. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 2,245 feet in length. The proposed access road would parallel the proposed pipeline. The proposed well-tie pipeline would parallel existing or proposed disturbance for its entire length. Where the proposed access road and well-tie pipeline are parallel, total construction width would be 50 feet. The remainder of the pipeline would be constructed within a 40-foot wide ROW. Five 24-inch culverts and two 36-inch culverts would be installed within the disturbance from the access road. There would be two turnouts constructed adjacent to the access road.. Construction of the proposed well-tie pipeline would require one approximately 125-foot by 282-foot TUA, resulting in approximately 0.74 acre of disturbance. Total surface disturbance would be 8.8 acres. After interim reclamation, 1.9 acres would remain long-term

disturbance (1.6 acres on the proposed well pad, 0.3 acre on the proposed access road) would remain in use for operation.

Drilling of the proposed Gallo Canyon Unit M15-2306 wells would require constructing a 400-foot by 400-foot well pad with a 50-foot-wide construction zone around the perimeter of the pad, resulting in a total disturbance of 5.74 acres. Maximum cut would be approximately 14.6 feet at centerline 4, and the maximum fill would be approximately 10.9 feet at corner 2. To access the pad, an approximate 435-foot access road would be constructed. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 519 feet in length. Two 24-inch culverts would be installed along the proposed access road. The proposed access road would parallel the proposed well-tie pipeline. Total construction width of the pipeline and access road would be 50 feet and would be designated as 20 feet of disturbance adjacent to the road and 30 feet of disturbance on the road. The proposed road and pipeline would result in 0.5 acre of disturbance. The remaining length of the pipeline would result in 0.06 acre of disturbance. Total surface disturbance of the proposed project would be approximately 6.3 acres. After interim reclamation, 1.8 acres (1.6 acres associated with the well pad and 0.2 acre for access) would remain in use for operation.

Drilling of the proposed Gallo Canyon Unit O15-2306 wells would require constructing a 400-foot by 430-foot well pad with a 50-foot-wide construction zone around the perimeter of the pad, resulting in a total disturbance of 6.08 acres. Maximum cut would be approximately 18.1 feet at corner 3, and the maximum fill would be approximately 17.7 feet at corner 6. To access the pad, an approximate 968-foot access road would be constructed. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 990 feet in length. The proposed access road would parallel the proposed well-tie pipeline. Where parallel, total construction width of the pipeline and access road would be 50 feet and would be designated as 20 feet of disturbance adjacent to the road and 30 feet of disturbance on the road. Three 24-inch culverts would be installed within the disturbance from the access road. There would be one turnout constructed adjacent to the access road, which would result in 0.05 acre of disturbance. The proposed road and pipeline would result in 1.1 acres of disturbance. The remaining 22 feet of the pipeline would be constructed within a 40-foot-wide corridor resulting in 0.02 acre of disturbance. The proposed road and pipeline would result in 1.2 acres of disturbance. Total surface disturbance for the proposed project would be approximately 7.3 acres. After interim reclamation, 2.0 acres would remain long-term disturbance (1.6 acres on the proposed well pad, 0.4 acre on the proposed access road, including turnout) would remain in use for operation.

Drilling of the proposed Gallo Canyon Unit P14-2306 wells would require constructing a 400-foot by 460-foot well pad with a 50-foot-wide construction zone around the perimeter of the pad, resulting in a total disturbance of 6.43 acres. Maximum cut would be approximately 24.4 feet at corner 6, and the maximum fill would be approximately 11.7 feet at corner 3. To access the pad, approximately 2,243-feet of access road would be constructed. Encana would also construct and operate a proposed well-tie pipeline, which would be approximately 1,561 feet in length. The proposed pipeline would parallel the proposed access road. Where parallel, total construction width of the pipeline and access road would be 50 feet and would be designated as 20 feet of disturbance adjacent to the road and 30 feet of disturbance on the road. The remaining length of the road would be constructed within a 30-foot ROW.

Six 24-inch culverts and one 36-inch culvert would be installed within the disturbance from the access road. Two turnouts would be constructed along the access road. The proposed road and pipeline would result in 2.4 acres of disturbance. Total surface disturbance of the proposed project would be approximately 8.8 acres. After interim reclamation, 2.7 acres (1.6 acres associated with the well pad and 1.1 acres for access) would remain in use for operation.

The proposed Gallo Canyon Unit North Trunk Pipeline would be approximately 10,514 feet in length. Approximately 10,429 feet would be constructed within a 40-foot-wide ROW on BLM-managed land and approximately 85 feet would be constructed within a 30-foot-wide ROW on state land. One TUA is proposed to bore under Rio Arriba County Road 379. This TUA would add an additional 0.05 acre of temporary disturbance. Total disturbance from the proposed pipeline and TUA would be approximately 9.8 acres.

Table 2-5 lists the total new, short, and long-term disturbance for the proposed action by land status.

Table 2-5. Short- and long-term disturbance for the proposed action by land status

Land Status	Short-term Disturbance (acres)	New Disturbance (acres)	Long-Term Disturbance (acres)[1]
Bureau of Land Management	76.9	62.0	20.0
State of New Mexico	0.6	0.6	0.00
Total	**77.5**	**62.6**	**20.0**

[1] Based on 20-foot-wide resource roads, 30-foot-wide collector road, and 1.6 acres per well pad for operation

Drilling and Completions

After access road and well pad construction is complete, Encana would mobilize a drilling rig to drill the wells from each pad. During drilling operations, equipment on the site would include:

- The drilling rig
- Stockpiles of drill pipe and casing
- A closed-loop system and aboveground tanks for collecting cuttings and fluids
- Mud shakers to separate the cuttings from the fluids
- Generators to provide power to the drill rig
- Office trailers equipped with sleeping quarters for essential personnel

Drilling operations would be conducted in compliance with all Federal Onshore Oil and Gas Orders, all applicable Federal and State of New Mexico rules and regulations, and BLM Notice to Lessees. The proposed wells would be horizontal wells targeting the Counselors-Gallup Dakota pool. The proposed wells would be drilled to a vertical depth greater than 5,000 feet and then horizontally drilled.

Using a fresh water-based drilling mud system, surface casing would be set to an approximate measured depth of 500 feet. After the surface casing is installed, it would be cemented in place by pumping

cement down the casing, circulating the cement back up the outside of the casing to create a cement sheath around the entire casing, and then tested to ensure the quality and integrity of the cement. Prior to drilling below the surface casing, a blowout preventer (BOP) would be installed on the surface casing, and both the BOP and surface casing would be pressure tested for integrity. After installation and testing of the BOP, a string of intermediate casing would be installed. The intermediate casing would be cemented, and then tested to ensure the quality and integrity of the cement.

After cementing the intermediate string, a synthetic oil-based drilling mud system would be used to drill the horizontal portion of the wellbore. Additives may be mixed with the mud system to achieve borehole stability, minimize possible damage to geologic formations, provide adequate viscosity to carry the drill cuttings out of the wellbore, and reduce downhole fluid losses.

After drilling the wellbore to its final depth, a production liner would be run and secured into place utilizing an external swell packer system. The production liner provides additional isolation of the wellbore and creates a pathway for natural gas or liquids to travel from the formation to the surface.

After the production liner has been secured into place, the drilling rig would be removed, and a completion rig moved to the site. The completion rig would run a completions string of the same size, weight, and grade as the production liner into the wellbore to tie-in to the liner/liner hanger, providing a secondary barrier during completions that protects intermediate casing from pressures needed to pump into the formation. During completions activities, the well pads would have completions rigs, completions command centers, steel storage tanks, pump trucks and transports, blending and mixing facilities, and related ancillary completions equipment.

Completing the wells would require hydraulic fracturing—the process of injecting water, sand, and a small amount of fluid additives into the wellbore under very high pressure to fracture the formation and release the oil. A series of charges would be set through the producing interval in the horizontal portion of the wellbore to perforate the production liner and casing and create small fractures in the target formation. A fluid and sand mixture would be injected at high pressure into the formation to create cracks or fractures, the sand would act as a proppant to keep the fractures open and allow oil to move more efficiently into the wellbore. The fracturing process would be done in stages, with each stage continuing in the same manner along the horizontal portion of the wellbore, using a series of plugs to isolate portions of the well that were previously fractured. After all of the stages are completed, the plugs would be drilled out to allow gas or oil to flow to the wellhead.

Completions would be designed with nitrogen foam to minimize water usage and improve fluid recoveries post-completions. Water would be sourced from a private water well located in the SW/NE ¼ of Section 32, of Township 25 North, Range 9 West, New Mexico Principal Meridian. This well is permitted by the State of New Mexico. The well has been assigned the Point of Diversion Number SJ 01979-S4 by the New Mexico Office of the State Engineer. Water would be stored on-site in steel storage tanks (up to 15).

Drilling activities would occur continuously for approximately 2 weeks per well and would require on-site supervision 24 hours a day. Completions activities are expected to take 1 to 3 weeks per well.

Production

Production facilities on the well pads would consist of wellheads, metering units, separators, aboveground condensate and produced water tanks (two tanks per well), and compressors. If artificial lift is required, conventional pumping units (pump jacks) and/or gas lift systems would be installed.

Tank batteries would be placed within corrugated steel secondary containment berms and would be sized to contain a minimum of 110 percent of the storage capacity of the largest tank within the berm. Containment berms would include an impermeable liner attached to the rings and laid under the tanks. All loading lines would be placed inside the containment berm or would have secondary containment vessels.

Installation of production equipment would take 2 to 3 weeks per well pad. Production facilities would be in place for the life of the wells, which are anticipated to be 30 to 50 years.

Pipeline Installation

The proposed well-tie pipelines would be up to a 6-inch outside diameter buried steel pipelines with a maximum allowable operating pressure of 500 pounds per square inch gauge. The proposed Gallo Canyon Unit North Trunk pipeline would be constructed using 12-inch outside diameter steel pipeline. Related aboveground appurtenances that would be installed within the pipeline workspace would include cathodic protection equipment, futures, and block valves with blowdowns. Gallo Canyon Unit North Trunk pipeline would also require aboveground pig launchers and receivers, meter, separator, tank with truck load out, cathodic protection equipment, and futures and block valves with blow-downs.

The trench line, or ditch, would be excavated and sloped in accordance with Occupational Safety and Health Administration specifications. The cover from top of pipe to ground level would be a minimum of 36 inches through typical soil and rock and a minimum depth of 48 inches at road crossings. Excavated material would be stockpiled at the edge of the workspace.

The trenching operation would be followed by pipe installation that would include stringing, bending for horizontal or vertical angles in the alignment, welding pipe segments together, inspection, coating joints to prevent corrosion, and lowering into the trench. Backfilling would begin after a section of the pipe has been successfully placed in the ditch and final inspection has been completed.

Cleanup activities would be initiated as soon as practicable after backfilling activities have been completed. The pipelines would be seeded with the seed mix and rates provided in the Reclamation Plan attached to the APDs for the well pads.

Construction and well-tie pipeline installation activities would take 4 to 6 weeks per pipeline and reclamation activities would take 1 to 2 weeks per well-tie pipeline. Construction of the proposed Gallo Canyon Unit North Trunk pipeline would take approximately 6 weeks. The pipelines and related aboveground appurtenances would be in place for the life of the wells, which are anticipated to be 30 to 50 years.

Interim Reclamation

After production facilities are installed at the pads, the size of the well pads would be reduced to the minimum surface area needed for production facilities and future operations. Interim reclamation would consist of grading and recontouring the portion of the well pad not needed for production facilities/future operations to blend with adjacent natural surroundings as much as practicable, covering with salvaged topsoil material, and seeding to re-establish vegetation. Seed mixtures and rates would be in accordance with the Reclamation Plan for the proposed action. Sediment and erosion control measures would be installed as necessary. Interim reclamation would reduce the disturbed area to approximately 1.6 acres per pad. The proposed pipeline ROWs would be reclaimed where they do not overlap the access roads. Approximately 20.0 acres associated with well operation and access would not be reclaimed.

Interim reclamation activities would be initiated within 120 days of final operations and would take 2 to 4 weeks per well pad.

Abandonment and Final Reclamation

Upon abandonment of the wells, the wellbores would be plugged with cement, and the production facilities would be removed. Federal and State of New Mexico standards would be followed and Encana would provide the BLM with technical and environmental aspects of the final plugging and abandonment and reclamation procedures. The well pads and access roads would be graded and re-contoured to blend with adjacent natural surroundings as much as practicable, covered with salvaged topsoil material, and seeded to re-establish vegetation. Sediment and erosion control measures would be installed as necessary.

2.1.1 Design Features

All areas of proposed surface disturbance were inspected in the field to ensure that potential impacts to natural resources would be minimized through the implementation of design features. For a detailed description of the design and construction practices associated with the proposed action, refer to the APDs and plats in Appendix B. For the proposed action, standard and project-specific design features include but are not limited to the following:

- Roads will be maintained in the same or better condition as what existed prior to the commencement of operations. Road maintenance will continue until final abandonment and reclamation of the well locations.
- Dust emissions will be controlled on the roads and locations, as necessary, with the application of dust suppressants (e.g., magnesium chloride) and/or water.
- The well pad access roads will be designed and constructed as Resource Roads, and the Gallo Canyon Unit North Access will be designed and constructed as a Collector Road in accordance with the BLM Gold Book Standards (USDI/USDA 2007) and BLM 9113-1 (Roads Design Handbook) and BLM 9113-2 (Roads National Inventory and Condition Assessment Guidance and Instructions Handbook). Construction will include ditching, draining, installing culverts, crowning

and capping or sloping and dipping the roadbed, and installing turnouts, as necessary, to provide a well-constructed and safe road.

- All BLM/FFO cultural resources stipulations will be followed as indicated in the Cultural Resource Records of Review, attached to the Conditions of Approval (COA) in the APD/ROW as the case may be. These stipulations may include, but are not limited to temporary or permanent fencing or other physical barriers, monitoring of earth-disturbing construction, reduction and/or specific construction avoidance zones, and employee education. All employees, contractors, and sub-contractors of the project will be informed by the project proponent that cultural sites are to be avoided by all personnel, personal vehicles, and company equipment. All employees, contractors, and sub-contractors of the project will also be informed that it is illegal to collect, damage, or disturb cultural resources and that such activities are punishable by criminal and/or administrative penalties under the provisions of the Archaeological Resources Protection Act. In the event of a discovery during construction, the project proponent will immediately stop all construction activities in the immediate vicinity of the discovery and then immediately notify the archaeological monitor, if present, or the BLM. The BLM will then evaluate or cause the site to be evaluated. Should a discovery be evaluated as significant (e.g., National Register, Native American Graves Protection and Repatriation Act, Archaeological Resources Protection Act), it will be protected in place until mitigating measures can be developed and implemented according to guidelines set by the BLM.
- Prior to construction, pipeline and road ROWs will be staked at 100- to 200-foot intervals.
- Grazing permittees will be notified when construction is scheduled to begin. All hazards to livestock will be fenced or contained.
- All project activities will be confined to permitted areas only.
- Where pipeline construction parallels or crosses public roads, warning signs will be placed to alert motorists of construction. Safety measures will also be implemented along the construction workspace by either using the topsoil or subsoil piles or strung pipe as a barrier. Trenches left open at road crossings will be fenced with orange safety fence, and barricades will be installed, if needed.
- Clearing, removal of topsoil, and grading will be limited to the minimum area required for safe and efficient construction.
- Trees larger than 3 inches in diameter will be cut at ground level and delimbed. Stumps will be cut as close to the ground as possible. Stumps and root balls will be hauled to an approved disposal site or stockpiled at the edge of the well pad and buried in the cut slopes of the pad during interim reclamation.
- Trees smaller than 3 inches in diameter, slash, and brush will be chipped, shredded, or mulched and will then be incorporated into the topsoil for later use in interim reclamation.
- Remaining brush will be brush-hogged or scalped at ground level prior to ground disturbance.
- Topsoil will be segregated and stockpiled at the edge of the workspace. Topsoil is defined as the top 6 inches of soil. Vehicle/equipment traffic will be prevented from crossing topsoil stockpiles.

- If a location becomes prone to wind or water erosion, Encana will take appropriate measures to prevent topsoil loss. Such measures may include using tackifiers or water to wet the topsoil stockpile to create a crust across the exposed soil to prevent soil loss.
- Culverts will be installed, as needed, along the new and upgraded access roads from the well pads to the arterial route. Culverts will be sized and installed in accordance with BLM Gold Book standards (USDI/USDA 2007) and BLM 9113-1 (Roads Design Handbook) and BLM 9113-2 (Roads National Inventory and Condition Assessment Guidance and Instructions Handbook).
- A closed-loop system will be used for each location. Cuttings will be stored on-site in aboveground storage tanks. Cuttings will be disposed at an approved waste disposal facility.
- The closed-loop system storage tanks will be sized to ensure confinement of all fluids and will provide sufficient freeboard to prevent uncontrolled releases.
- A 20-millimeter thick liner will be installed under tanks, pumps, ancillary facilities, and truck loading/unloading areas associated with the closed-loop system.
- Drilling fluids will be stored on-site in aboveground storage tanks. Upon termination of drilling operations, the drilling fluids will be recycled and transferred to other permitted closed-loop systems or returned to the vendor for reuse, as practical. Residual fluids will be disposed of at an approved waste disposal facility.
- The water-based solution that flows back to the surface during and after completion operations will be placed in storage tanks on the location. Flowback water will be confined to a storage tank for a period not to exceed 90 days after initial production and will be disposed of at an approved waste disposal facility.
- Any spills of non-freshwater fluids will be immediately cleaned up and removed to an approved disposal site.
- Self-contained chemical toilets will be provided for human waste disposal. The toilet holding tanks will be pumped, as needed, and the contents thereof disposed of in an approved sewage disposal facility. Toilets will be on-site during all operations.
- Garbage, trash, and other waste materials will be collected in a portable, self-contained, and fully-enclosed trash container during drilling and completion operations. The accumulated trash will be removed, as needed, and will be disposed of at an authorized sanitary landfill. No trash will be buried or burned on location.
- Immediately after removal of the drilling rig, all debris and other waste materials not contained in the trash container will be cleaned up and removed from the well location.
- No chemicals subject to reporting under SARA Title III in an amount equal to or greater than 10,000 pounds will be used, produced, stored, transported, or disposed of annually in association with the drilling, testing, or completing of this well.
- No extremely hazardous substances, as defined in 40 CFR 355, in threshold planning quantities, will be used, produced, stored, transported, or disposed of in association with the drilling, testing, or completing of this well.

- The amount of open trench will be minimized ahead of pipe laying and backfilling. No more than ½ mile of trench or the amount of trench that can be worked in a day will be open at any given time. Backfilling operations will be performed within a reasonable amount of time of the lowering operation to ensure the trench is not left open for more than 24 hours. Trenches left open overnight will be fenced with a temporary fence or other methods approved by the Authorized Officer.
- Escape ramps/crossovers will be constructed every 1,320 feet. In areas where active grazing is taking place escape ramps/crossovers will be placed every 500 feet. The ends of the open trench will be sloped each night with a 3:1 slope.
- Established livestock and wildlife trails will be left in place as crossovers. Escape ramps/crossovers will be constructed with a minimum 3:1 slope at each end of the crossover. Crossovers will be a minimum of 10 feet wide and not fenced.
- The end of the pipe will be plugged to prevent animals from crawling in.
- Before the trench is closed, it will be inspected for animals. Any trapped wildlife or livestock will be promptly removed and released at least 150 yards from the trench.
- All existing improvements (such as fences, gates, and bar ditches) will be repaired to previous or better than pre-construction conditions. Cut fences will be tied to H-braces prior to cutting and openings will be protected as necessary during construction to prevent the escape of livestock. A temporary closure will be installed on the same day as the fence is cut. Following reclamation, the fence will be reconstructed to BLM specifications.
- Cover from top of pipe to ground level will be a minimum of 36 inches through typical soil and rock and a minimum of 48 inches at drainage of road crossings. Inspection will be conducted to verify that minimum cover is provided, the trench bottom is free of rocks and debris, external pipe coating is not damaged, and the pipe is properly fitted and installed into the ditch.
- Rocks and limbs removed during clearing will be scattered across the workspace in a random arrangement using rubber-tired equipment.
- Open pits will be netted and vent caps placed on all open pipes to prevent bird entry and nesting.
- A migratory bird nest survey will be conducted if any vegetation-disturbing activities occur between May 15 and July 31. The survey must be conducted by a BLM-approved biologist using a survey protocol developed and provided by the BLM/FFO. If active nests are located within the proposed permitted area, project activities will not be permitted without written approval by a BLM/FFO biologist.
- Permanent erosion control measures will be installed after the workspace has been re-contoured. Encana will construct waterbars on all disturbed areas to the spacing and cross sections specified by the Authorized Officer.
- The disturbed areas will be reseeded with a BLM/FFO approved seed mix, a Sagebrush-Grass Community mix as determined during the project on-sites. Seeding will be accomplished within 120 days of construction completion, weather permitting. Upon evaluation after the second

growing season, seeding will be repeated if a satisfactory stand is not obtained. Cut and fill slopes will be hand seeded with hydro-mulch excelsior netting and/or mulch with netting.

- It will be the operator's responsibility to monitor, control, and eradicate all noxious weed species within the permitted area throughout the life of the proposed project. The operator will contact the BLM/FFO regarding acceptable weed-control methods. If the operator does not hold a current Pesticide Use Permit, a Pesticide Use Permit will be submitted prior to pesticide application. Only pesticides authorized for use on BLM lands will be used. The use of pesticides will comply with federal and state laws. Pesticides will be used only in accordance with their registered use and limitations. The operator will contact the BLM/FFO prior to using these chemicals.
- Production equipment will be placed on location in such a manner to minimize long-term disturbance and maximize interim reclamation. As practical, access will be provided by a teardrop-shaped road through the production area so that the center may be re-vegetated.
- A berm will be constructed completely around any production facilities that contain fluids (i.e., production tanks, produced water tanks, etc.). These berms will be constructed of compacted subsoil, impervious corrugated metal or equivalent, and will hold 110 percent of the capacity of the largest tank.
- Production facilities will be painted Juniper Green to blend with the natural color of the landscape and will be located, to the extent practical, to reasonably minimize visual impact. Equipment subject to safety considerations would not be painted.
- Engines will be equipped with mufflers and barriers or other soundproofing measures would be implemented, if needed, to meet the requirements of BLM Notice to Lessees and Operators on Onshore Oil and Gas Leases within the jurisdiction of the FFO NTL 03-1 FFO.

Site-Specific Design Features for the Lybrook E13-2306

- The road will be upgraded, the old culvert will be removed, and a low water crossing will be constructed in the drainage crossed by the access.
- Material from excavation will be used to support and stabilize the underneath portion of the exposed pipe at the drainage crossing. Placing material on top of the pipeline will be avoided.
- Culverts will be installed along the access road as described above and shown in the project plats.
- Water will be diverted around the well pad, and silt traps will be installed as needed upon interim reclamation.

Site-Specific Design Features for the Lybrook I14-2306

- Three large silt traps will be constructed on the east side of the well pad between corners 2 and 6 to drain north toward corner 6.
- Culverts will be installed along the access road as described above and shown in the project plats.

- Water will be diverted around the well pad, and additional silt traps will be installed as needed upon interim reclamation.

Site-Specific Design Features for the Gallo Canyon Unit M14-2306

- Culverts will be installed along the access road as described above and shown in the project plats.
- Water will be diverted around the well pad, and silt traps will be installed as needed upon interim reclamation.

Site-Specific Design Features for the Gallo Canyon Unit M15-2306

- A low water crossing will be constructed across the drainage crossed by the access road.
- Culverts will be installed along the access road as described above and shown in the project plats.
- Water will be diverted around the well pad, and silt traps will be installed as needed upon interim reclamation.
- Noise stipulations will be implemented for production equipment to minimize impacts to nearby residences.

Site-Specific Design Features for the Gallo Canyon Unit O15-2306

- The gate will be replaced by a cattle guard with 16-foot gates on either side.
- Water will be diverted around the well pad and silt traps will be installed as needed upon interim reclamation.
- Culverts will be installed along the access road as described above and shown in the plats.

Site-Specific Design Features for the Gallo Canyon Unit P14-2306

- Water will be diverted around the well pad, and silt traps will be installed as needed upon interim reclamation.
- Culverts will be installed along the access road as described above and shown in the project plats.
- Grazing allottee will be contacted for permission to clean out pond.

Site-Specific Design Features for the Gallo Canyon Unit North Trunk Pipeline

- The County Road 379 crossing will be bored.

2.2 No Action

The BLM NEPA Handbook (H-1790-1; USDI/BLM 2008a) states that for EAs on externally initiated proposed actions, the no action alternative is generally to reject the proposal or deny the application. This option is provided in 43 CFR 3162.3-2 (h) (2). This alternative would deny the approval of the APDs and ROW grants and the current land and resource uses would continue in the area. The no action

alternative provides a useful baseline for comparison of environmental effects (including cumulative effects) and demonstrates the consequences of not meeting the need for the action.

2.3 Alternatives Considered but Eliminated

The applicant analyzed several scenarios to determine how to best develop Sections 13, 14, 22, 23, 24, and 25, Township 23 North, Range 6 West. Using desktop tools and in-field examination, several configurations of the proposed well pads, pipelines, and roads were considered and evaluated by the applicant, the BLM, and natural and cultural resources experts. These alternatives were considered, but have been eliminated from further consideration as they would have resulted in greater environmental impacts or would not have met the proposed action's purpose and need.

Lybrook I14-2306

The original location (Lybrook L13-2306) would have been located on top of the mesa and was eliminated from consideration due to archeology and topography. A second alternative was moved approximately 150 feet away from the cliff base because of drainage issues.

Gallo Canyon Unit M14-2306

Twinning the proposed Gallo Canyon Unit M14-2306 with an existing Dugan Production Company well located to the southwest was considered, but eliminated due to archaeology.

Gallo Canyon Unit O15-2306

The original pipeline and access road alignment for Gallo Canyon Unit O15-2306 were moved to minimize the amount of cut and fill.

Gallo Canyon Unit P14-2306

The access road for Gallo Canyon Unit P14-2306 was moved to utilize more of the existing disturbance and minimize new disturbance.

Gallo Canyon Unit North Trunk Pipeline

To minimize new disturbance, sections of the proposed pipeline were modified to follow the existing road and pipeline corridor.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the environment that would be affected by implementation of the alternatives described in Chapter 2. Aspects of the affected environment described in this section focus on the relevant major resources or issues. Under the no action alternative, the proposed action would not be implemented. The no action alternative would result in the continuation of the current land and resource uses in the area. This alternative will not be evaluated further in this EA.

Ecosphere Environmental Services (Ecosphere) biologists conducted field resource investigations of the proposed action on various dates between December 2013 and December 2014. Cultural resource surveys were conducted by La Plata Archaeological Consultants, LLC (LAC) on various dates between October 2012 and March 2014. On-site evaluations were conducted on March 11 and April 16 and 21, 2014 and attended by representatives from Encana, Ecosphere, LAC, and the BLM/FFO.

The analysis area for this EA is defined as the project footprint of the proposed well pads, access roads, and pipelines.

3.1 Air Resources

3.1.1 Affected Environment

The proposed action would be located in Sandoval and Rio Arriba Counties, New Mexico. Additional general information on air quality in the area is contained in Chapter 3 of the Farmington PRMP/FEIS. In addition, new information about greenhouse gases (GHGs), including their effects on national and global climate conditions, has emerged since this document was prepared. On-going scientific research has identified the potential impacts of GHG emissions such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_X), water vapor, and several trace gases on global climate. Through complex interactions on a global scale, GHG emissions may cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and burning of fossil carbon sources have caused GHG concentrations to increase measurably, and may contribute to overall climatic changes, typically referred to as global warming.

Much of the information referenced 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 Air Resources Technical Report (USDI/BLM 2014). This document summarizes the technical information related to air resources and climate change associated with oil and gas development, and the methodology and assumptions used for analysis.

The United States Environmental Protection Agency (USEPA) has the primary responsibility for regulating air quality, including six nationally regulated ambient air pollutants (criteria pollutants). These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM) that includes a PM with a diameter between 2.5 and 10 micrometers (PM_{10}) and a PM with a

diameter of 2.5 micrometers or less ($PM_{2.5}$), sulfur dioxide (SO_2) and lead (Pb). The USEPA has established National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. The NAAQS are protective of human health and the environment. The USEPA has approved New Mexico's State Implementation Plan, and the state enforces state and federal air quality regulations on all public and private lands within the state, except for tribal lands and within Bernalillo County. Air quality is determined by atmospheric pollutants and chemistry, dispersion meteorology and terrain, and includes applications of noise, smoke management, and visibility. Climate is the composite of generally prevailing weather conditions of a particular region throughout the year, averaged over a series of years. The USEPA has proposed or completed actions recently to implement Clean Air Act requirements for greenhouse gas emissions. Climate has the potential to influence renewable and non-renewable resource management.

Air Quality

The Air Resources Technical Report describes the types of data used to describe the existing conditions of criteria pollutants, how the criteria pollutants are related to the activities involved in oil and gas development, and provides a table of current National and state standards. The USEPA's Green Book web page reports that all counties in the FFO planning area are in attainment of all NAAQS, as defined by the Clean Air Act (USEPA 2013a). The area is also in attainment of all New Mexico Ambient Air Quality Standards (NMAAQS*).* The current status of criteria pollutant levels in the FFO are described below. Total emissions of criteria pollutants from each source sector were calculated by adding together the emissions from the four counties that are located in FFO: San Juan, McKinley, Rio Arriba, and Sandoval.

"Design concentrations" are the concentrations of air pollution at a specific monitoring site that can be compared to the NAAQS. The 2012 design concentrations of criteria pollutants are listed below in Table 3-1. There is no monitoring for CO or Pb in San Juan County, but because the county is relatively rural, it is likely that these pollutants are not elevated. PM_{10} design concentrations are not available for San Juan County.

Table 3-1. Criteria pollutant-monitored values in San Juan County

Pollutant	Design Value	Averaging Time	NAAQS	NMAAQS
O_3	0.071 ppm	8-hour	0.075 ppm[(1)]	
NO_2	13 ppb	Annual	53 ppb[(2)]	50 ppb
NO_2	38 ppb	1-hour	100 ppb[(3)]	
$PM_{2.5}$	4.7 μg/m^3	Annual	12 μg/m^3 [(4)]	60 μg/m^3 [(6)]
$PM_{2.5}$	14 μg/m^3	24 hour	35 μg/m^3 [(3)]	150 μg/m^3 [(6)]
SO_2	19 ppb	1-hour	75 ppb[(5)]	

[(1)] Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.

[(2)] Not to be exceeded during the year.

[(3)] 98th percentile, averaged over 3 years.

[(4)] Annual mean, averaged over 3 years.

[(5)] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

[(6)] The NMAAQS is for Total Suspended Particulate.

Note: NAAQS = National Ambient Air Quality Standard Standards; NMAAQS = New Mexico Ambient Air Quality Standards; O_3 = ozone; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter with a diameter of 2.5 micrometers or less; ppb = parts per billion; ppm = parts per million; SO_2 – sulfur dioxide; $\mu g/m^3$ = micrograms per cubic meter.
Source: USEPA 2014

In 2005, the USEPA estimated that there was less than 0.01 ton per square mile of Pb emitted in FFO counties, which is less than 2 tons total (USEPA 2012). Lead emissions are not an issue in this area and will not be discussed further.

Air quality in a given region can 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 (101-150), unhealthy (>150), very unhealthy and hazardous 151-300). The AQI is a national index, the air quality rating and the associated level of health concern is the same everywhere in the country. The AQI is an important indicator for populations sensitive to air quality changes.

Mean AQI values for San Juan County were generally in the good range (AQI<50) in 2013, with 80 percent of the days in that range. The median AQI in 2013 was 42, which indicates “good” air quality. The maximum AQI in 2013 was 156, which is considered “unhealthy.”

Although the AQI in the region has reached the level considered unhealthy for sensitive groups on several days almost every year in the last decade, there are no patterns or trends to the occurrences (Table 3-2). During the past decade, the air quality reached an “unhealthy” level on 8 days in the past decade, and on 2 days, the air quality reached the level of “very unhealthy.” In 2009 and 2012, there were no days that were “unhealthy for sensitive groups” or worse in air quality. In 2005 and 2013, there was 1 day that was “unhealthy” during each year. In 2010, there were 5 “unhealthy” days and 2 “very unhealthy days.”

Table 3-2. Number of days classified as “unhealthy for sensitive groups” (AQI 101-150) or worse

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Days	3	6	9	18	1	0	12	9	0	1

Source: USEPA 2013b

Hazardous Air Pollutants

The Air Resources Technical Report discusses the relevance of hazardous air pollutants (HAPs) to oil and gas development and the particular HAPs that are regulated in relation to these activities (USDI/BLM 2014). The USEPA conducts a periodic National Air Toxics Assessment (NATA) that quantifies HAP emissions by county in the U.S. The purpose of the NATA is to identify areas where HAP emissions result in high health risks and further emissions reduction strategies are necessary. A review of the results of the 2005 NATA shows that cancer, neurological, and respiratory risks in San Juan County are generally

lower than statewide and national levels as well as those for Bernalillo County, where urban sources are concentrated in the Albuquerque area (USEPA 2012).

Climate

The analysis area is located in a semi-arid climate region, typified by dry windy conditions and limited rainfall. Summer maximum temperatures are generally in the range of 80 or 90 degrees Fahrenheit (°F), and winter minimum temperatures are generally in the teens to 20s. Temperatures occasionally reach above 100°F in June and July, and have dipped below 0°F in December and January. Precipitation is divided between summer thunderstorms associated with the southwest monsoon and winter snowfall as Pacific weather systems drop south into New Mexico.

Table 3-3 shows climate normals for the 30-year period from 1981 to 2010 for the Farmington, New Mexico area.

Table 3-3. Climate normals for the Farmington area, 1981-2010

Month	Average Temperature[1]	Average Maximum Temperature[1]	Average Minimum Temperature[1]	Average Precipitation (inches)
January	30.5	40.8	20.3	0.53
February	35.8	46.8	24.8	0.59
March	43.2	56.1	30.3	0.78
April	50.4	64.7	36.2	0.65
May	60.4	74.8	46.1	0.54
June	69.8	85.1	54.5	0.21
July	75.4	89.6	61.2	0.90
August	73.2	86.5	59.8	1.26
September	65.4	79.1	51.7	1.04
October	53.3	66.4	40.1	0.91
November	40.5	52.2	28.8	0.68
December	31.0	41.2	20.7	0.50

Source: USDI/BLM 2014

[1] Degrees Fahrenheit

Very recently, pioneering research using space-borne (satellite and aircraft) determination of methane concentrations have indicated anomalously large methane concentrations may occur in the Four Corners region (Kort et al. 2014). A subsequent study (Schneising et al. 2014) indicated larger anomalies over other oil and gas basins in the U.S. Methane is 34 times more potent at trapping greenhouse gas emissions than CO_2 when considering a time horizon of 100 years (Intergovernmental Panel on Climate Change, 2013). While space-borne studies can determine the pollutant concentration in a column of air, these studies cannot pinpoint the specific sources of air pollution. Further study is required to determine the sources responsible for methane concentrations in the Four Corners region; however, it is known that a significant amount of methane is emitted during oil and gas well completion (Howarth et al. 2011). Methane is also emitted from process equipment, such as pneumatic controllers, and liquids unloading at oil and gas production sites. Ground-based, direct source monitoring of pneumatic

controllers conducted by the Center for Energy and Environmental Resources (Allen et al. 2014b) show that methane emissions from controllers exhibit a wide range of emissions, and a small subset of pneumatic controllers emitted more methane than most. Emissions measured in the study varied significantly by region of the U.S., the application of the controller and whether the controller was continuously or intermittently venting. The Center for Energy and Environmental Resources had similar findings of variability of methane emissions from liquid unloading (Allen et al. 2014a). In October 2012, USEPA promulgated air quality regulations controlling volatile organic compounds (VOC) emissions at gas wells. These rules require air pollution mitigation measures that reduce the emissions of VOCs. These same mitigation measures have a co-benefit of reducing methane emissions. Future ground-based and space-borne studies planned in the Four Corners region with emerging pollutant measurement technology may help to pinpoint significant, specific sources of methane emissions in the region.

The Air Resources Technical Report summarizes information about GHG emissions from oil and gas development and their effects on national and global climate conditions. While it is difficult to determine the spatial and temporal variability and change of climatic conditions, what is known is that increasing concentrations of GHGs are likely to accelerate the rate of climate change.

3.1.2 Impacts from the Proposed Action

Methodology and assumptions for calculating air pollutant and greenhouse gas emissions are described in the Air Resources Technical Report (USDI/BLM 2014). This document incorporates the sections discussing the modification of calculators developed by the BLM to address emissions for one horizontal oil well. The calculators give an approximation of criteria pollutant, HAP, and GHG emissions to be compared to regional and national emissions levels. Also incorporated into this document are the sections describing the assumptions used in developing the inputs for the calculator (USDI/BLM 2014).

Direct and Indirect Impacts

Table 3-4 shows estimated emissions from one proposed conventional oil well for criteria pollutants, VOCs and GHGs. For comparison, Table 3-5 shows total human-caused emissions for each of the counties in the FFO and La Plata County, Colorado, based on USEPA's 2011 emissions inventory (USEPA 2014).

Table 3-4. Criteria pollutant and VOC emissions estimated for construction of one horizontal oil well; average 25 days to drill and complete

Activity	NOx	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	CH_4	CO_2
One time operations (tons)*								
Construction	5.5	1.5	0.5	2.5	0.25	0.1	0.007	598.85
Completion	0.5	0.1	0.03	0.025	0.025	-	-	55.00
Interim Reclamation	0.006	0.006	0.006	0.001	-	0.003	-	1.24
Final Reclamation	0.006	0.006	0.006	0.001	-	0.004	-	1.66

Ancillary operations (tons)								
Workover	0.129	0.04	0.01	0.01	0.01	-	-	10.59
Road Maintenance	-	-	-	-	-	-	-	0.26
Road Traffic	-	-	-	-	-	-	-	0.06
Annual operations (tons/year)								
Oil Haul Truck and Small Truck (100 bbls/day)	0.009	0.006	0.0012	0.0009	0.0008	-	0.0001	3.88
Total	**6.13**	**1.64**	**0.55**	**2.54**	**0.29**	**0.11**	**0.01**	**671.54**

Notes: NO_X = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter with an aerodynamic diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 2.5 microns; SO_2 = sulfur dioxide; CH_4 = methane; CO_2 = carbon dioxide; bbl = barrel.

Oil storage tanks on the well location may result in venting of VOC. Oil well production is generally presented as barrels (bbl) per day produced. The emissions calculator estimated that for every bbl per day produced there may be 0.12 tons of VOC vented per year.

The average horizontal oil well in the planning area produces approximately 100 barrels per day. One hundred barrels per day is estimated to result in 12 tons of VOC emissions per year. Oil storage tanks would be subject to current USEPA regulations regarding the capture or flaring of VOC emissions.

Table 3-5. Analysis area emissions in tons/year, 2011

County	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
McKinley	11,952.9	17,007.8	3,891.2	70,096.4	7,645.2	1,381.1
Rio Arriba	12,012.3	27,344.6	19,149.8	33,761.2	4,130.6	60.4
San Juan	42,231.5	63,568.9	26,110.8	76,638.3	9,201.0	5,559.3
Sandoval	4,143.8	19,513.9	4,373.1	39,343.0	4,510.8	109.3
La Plata	4,838.2	17,116.3	3,740.1	2,330.0	919.6	127.9
Total	**75,187.7**	**144,551.5**	**57,265.1**	**222,168.9**	**26,407.2**	**7,237.9**

Note: NO_X = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter with an aerodynamic diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 2.5 microns; SO_2 = sulfur dioxide.

Table 3-6 displays the percent increase in total emissions in the analysis area from the proposed action to construct and operate one horizontal oil well.

Table 3-6. Percent increase in analysis area emissions from the proposed action

	NO_X	CO	VOC(1)	PM_{10}(2)	$PM_{2.5}$(2)	SO_2(2)
Total Emissions	70,340.5	127,435.2	53,525.0	219,838.9	25,487.6	7,110.0
Conventional Gas Well Emissions	6.13	1.64	12.55	2.54	0.29	0.11
Percent Increase	**0.008**	**0.001**	**0.02**	**0.001**	**0.001**	**0.002**

Notes: NO_X = nitrogen oxides; CO = carbon monoxide; VOC = volatile organic compounds; PM_{10} = particulate matter with an aerodynamic diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter equal to or less than 2.5 microns; SO_2 = sulfur dioxide.

(1) Current USEPA regulations require operators to reduce VOC emissions by 95 percent if their oil storage tanks emit over six tons of VOC emissions per year.

(2) Values derived from average emissions for any well drilling in the analysis area; calculated results available upon request.

Hazardous Air Pollutants

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 percent of VOC emissions. Therefore, the estimated HAP emissions of 1.25 tons/year should be considered a very gross estimate. Most of the VOC emissions estimated for one horizontal oil well result from venting from oil storage tanks. Current USEPA regulations require operators to reduce VOC emissions by 95 percent if their oil storage tanks emit over 6 tons of VOC emissions per year. A reduction of 95 percent of oil storage tank VOC emissions would reduce the estimated HAP emissions to 0.12 tons/year.

Total Greenhouse Gases

The available statewide GHG summary combines GHG emissions from CO_2 and CH_4. To compare the GHG emissions from the proposed action estimated by the calculator with statewide GHG emissions, the carbon dioxide equivalent (CO_2e) emissions for both CH_4 and CO_2 were summed. The total statewide GHG emission estimate for 2007 was 76,200,000 metric tons CO_2e (76.2 million metric tons) (NMED 2010). The estimated CO_2e metric tons emissions from one horizontal oil well (609.2 metric tons) would represent a 0.0008 percent increase in New Mexico CO_2 emissions.

Cumulative Impacts

The FFO manages federal hydrocarbon resources in San Juan, Sandoval, Rio Arriba, and McKinley Counties. There are approximately 21,150 active oil and gas wells in the San Juan Basin. About 14,843 of the wells in these counties are federal wells. Analysis of cumulative impacts for reasonable development scenarios (RFDS) of oil and gas wells on public lands in the FFO was presented in the 2003 RMP. This included modeling of impacts on air quality. A more detailed discussion of Cumulative Effects can be found in the Air Resources Technical Report (USDI/BLM 2014).

The primary activities that contribute to levels of air pollutant and GHG emissions in the Four Corners area are electricity generation stations, fossil fuel industries, and vehicle travel. The Air Quality 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 (USDI/BLM 2014). 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 emissions calculator estimated that there could be very small direct and indirect increases in several criteria pollutants, HAPs, and GHGs as a result of implementing the proposed alternative. The very small increase in emissions that could result would not be expected to result in exceeding the NAAQS for any criteria pollutants in the analysis area.

The very small increase in GHG emissions that could result from implementing the proposed alternative would not produce climate change impacts that differ from the no action alternative. This is because 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 the action alternatives cannot be translated into effects on climate change globally or in the area of this site-specific action. It is currently not feasible to predict with certainty the net impacts from the action alternatives on global or regional climate.

The Air Resources Technical Report (USDI/BLM 2014) 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.

3.2 Water Resources/Quality – Surface and Groundwater

3.2.1 Affected Environment

The analysis area is located in the Upper Colorado River Hydrologic Region and is within of the Largo sub-watershed. The analysis area is characterized by level to moderately rolling sagebrush shrublands and scattered open canopy piñon-juniper woodlands in and to the west of Gallo Canyon. Surface drainage from the eastern side of the analysis area flows northeast to Gallo Canyon. Surface drainage from the western side of the analysis area flows north to the head of Haynes Canyon and then into Escrito Canyon. Both Gallo Canyon and Escrito Canyon empty into Largo Canyon north of the analysis area. There are no perennial surface water resources such as rivers, lakes, ponds, or streams nor any wetlands or springs within the analysis area. Seasonal stock ponds are located approximately 350 feet east of Station 22+50 on the proposed Gallo Canyon Unit North Trunk pipeline and approximately 100 feet south of Station 54+50 on the proposed Gallo Canyon Unit North Access Road.

The analysis area was surveyed for the presence of jurisdictional wetlands and other waters of the U.S. Where the proposed project would potentially impact "bluelines," as identified by the USGS High-resolution National Hydrography Dataset, a field determination was made as to whether the drainage feature supported a defined bed-and-bank feature (based on scour and deposition processes). If scour and deposition features were present, an assessment was made to determine which geomorphic features were representative of an ordinary high water mark. Waters of the U.S. and other wetlands are regulated by the U.S. Army Corps of Engineers. Table 3-7 provides a description of jurisdictional waters of the U.S. that were identified in the analysis area.

Table 3-7. Project component, ordinary high water mark measurement, and type of waters of the U.S. in the analysis area

Project Component	Ordinary High Water Mark		Type
	Width (inches)	Height (inches)	
Lybrook E13-2306 pipeline/access	40	4	NHD blueline

	56	4	NHD blueline
	60	5	NHD blueline
	18	2	Ephemeral
Lybrook E13-2306 upgraded access road	38	3	Ephemeral
Gallo Canyon Unit M14-2306 well pad	12	1	Ephemeral
Gallo Canyon Unit M14-2306 access road	84	4	NHD blueline
Gallo Canyon Unit M15-2306 pipeline/access	18	3	NHD blueline
Gallo Canyon Unit P14-2306 pipeline/access	18	2	Ephemeral

Note: NHD = National Hydrography Dataset

Aquifers in the San Juan Basin are generally considered to be confined and artesian due to the overlying low hydraulic conductivity formations and the regional geologic structure. Groundwater recharge occurs along the topographic high outcrops along the basin margins. Discharge from groundwater aquifers generally occurs in topographic low areas such as the San Juan River in the northwestern part of the basin and the Rio Grande in the southeast. Vertical leakage across fine-grained formations is also a source of recharge and discharge due to variations in hydraulic head. Regionally vertical leakage is assumed to be low however fracturing in particular around structural features in the basin could result in higher rates of vertical permeability (Stone et al. 1983).

The primary aquifers in the BLM/FFO area are the sandstone based Uinta-Animas and the Mesaverde. Groundwater is readily available in most of the BLM/FFO area and is of fair to poor quality. A search of the New Mexico State Engineers Office–Water Administration and Technical Engineering Resource System database for the proposed analysis area and vicinity (1-mile radius) was performed. There is record of one water well located at Counselor, which was drilled in 1948 to a measured depth of 280 feet. When drilled, the well yielded an estimated 7 gallons per minute (NMOSE 2013).

3.2.2 Impacts from the Proposed Action

Direct and Indirect Impacts

Potential impacts to surface water and shallow groundwater resources could occur from stormwater runoff and the accidental spill of chemicals, produced water, or flowback fluids. The potential for these impacts would be long term for the life of the proposed action.

The proposed action would temporarily expose an estimated 77.5 acres of soil as a sediment source entering area drainage ways in the short term, and approximately 20.0 acres would remain exposed on well pads and access roads after interim reclamation. Vegetation cover is generally low to moderate throughout the analysis area. Exposure of soils, particularly on slopes, would lead to an increase in an undetermined but likely small amount of sediment transport, particularly during and following storm events. Slight alterations in analysis area drainage patterns may also lead to an increase in sediment transport. These increases in sediment transport would persist for several years until the disturbed areas are stabilized. The potential for sediment transport into the drainages would be minimized through the implementation of best management practices and other preventive measures, such as re-establishment of vegetation and proper site hydrological diversions.

Two locations along the two-track road that would be upgraded for the Gallo Canyon Unit North Access Road would require erosion repair. These locations are currently eroding and encroaching upon the existing two-track road. During construction of the access road, proper drainage features would be installed at these locations. Constructing the road to applicable standards and installing adequate drainage features would result in long-term beneficial impacts and would decrease the sediment transfer into the upper reaches of Gallo Canyon.

The disturbance created by the proposed Lybrook E13-2306, Gallo Canyon Unit M14-2306, M15-2306, and P14-2306 well-tie pipelines and access roads within the ordinary high water mark of waters of the U.S. would be covered under U.S. Army Corps of Engineers Nationwide Permit #12 (Utility Line Activities). The disturbance created within the ordinary high water mark of the drainage within the proposed Gallo Canyon M14-2306 well pad would be cover under U.S. Army Corps of Engineers Nationwide Permit #12 (Commercial and Institutional Developments). Encana would consult with the U.S. Army Corps of Engineers and provide a pre-construction notification for authorization of Nationwide Permit #39 prior to disturbance.

Water for drilling and completions would be sourced from a private water well that has been permitted by the State of New Mexico. The New Mexico Office of the State Engineer assigned the well the Point of Diversion (POD) Number SJ 01979-S4. Approximately 1.3 million gallons of water would be used for drilling and completions per well.

Minimal amounts of hazardous materials (i.e., gas, diesel, etc.) would be used and stored on the well pad locations. There would be the potential for accidental spills or releases of these materials that could impact local water quality. The proposed wells would be drilled using a closed-loop system to contain drill cuttings and fluids. All chemicals stored on-site would be properly contained. Containment structures sufficiently impervious to prevent a discharge to waters of the U.S., such as containment dikes, containment walls, drip pans, or equivalent protective structures would be installed and maintained. Any spills of non-freshwater fluids would be immediately cleaned up and removed to an approved disposal site in accordance with federal and state regulations.

Stimulation (i.e., hydraulic fracturing or “fracking”) is a process used to maximize the extraction of underground resources by allowing oil or natural gas to move more freely from the rock pores to production wells that bring the oil or gas to the surface. Fluids, commonly made up of water (99 percent) and chemical additives (1 percent), are pumped into a geologic formation at high pressure during hydraulic fracturing (USEPA 2004). Chemicals added to stimulation fluids may include friction reducers, surfactants, gelling agents, scale inhibitors, acids, corrosion inhibitors, antibacterial agents, and clay stabilizers. When the fracking pressure exceeds the rock strength, the fluids open or enlarge fractures in the rock that typically extend several hundred feet away from the well bore, and may occasionally extend up to 1,000 feet from the well bore. After the fractures are created, a propping agent (usually sand) is pumped into the fractures to keep them from closing when the pumping pressure is released. After fracturing is completed, a portion of the injected fracturing fluids returns to the wellbore and is recovered for future fracturing operations (USEPA 2004) or disposal. Stimulation techniques have been used in the United States since 1949 and in the San Juan Basin since the 1950s.

Over the last 10 years, advances in multi-stage and multi-zone hydraulic fracturing have allowed development of gas fields that previously were uneconomic, including the San Juan Basin.

Hydraulic fracturing is a common process in the San Juan Basin and applied to nearly all wells drilled. The producing zone targeted by the proposed action is well below any underground sources of drinking water. The Mancos Shale formation is also overlain by a continuous confining layer. The geological confining layer is the Lewis Shale formation that is located above both the Mancos Shale and Mesaverde formations and provides an impermeable layer that isolates the Mancos Shale and Mesaverde formations from both identified sources of drinking water and surface water. On average, total depth of the proposed well bores would be more than 5,000 feet below the ground surface. Fracturing in the Basin Mancos formation is not expected to occur above depths of 4,000 feet below the ground surface. Fracturing could possibly extend into the Mesaverde formation overlying the Basin Mancos; however, the formation has not been identified as an underground source of drinking water based on its depth and relative high levels of total dissolved solids. No impacts to surface water or freshwater-bearing groundwater aquifers are expected to occur from hydraulic fracturing of the proposed wells.

Potential impacts to groundwater resources could occur from the proposed well bores. The potential for impacts to groundwater from the well bore would be long term for the life of the well. Adherence to COA and design features, such as adequate casing, cementing, and other drilling and completion methods, would minimize effects to water quality.

Casing specifications would be designed by Encana, and a casing program would be submitted to the New Mexico Oil Conservation Division. Surface casing would be set to 500 feet. The casing and cementing would stabilize the wellbore and provide protection to any overlying freshwater aquifers by isolating hydrocarbon zones from overlying freshwater aquifers. Prior to approving an APD, a BLM geologist would identify all potential subsurface formations that would be penetrated by the wellbore. This includes all groundwater aquifers and any zones that would present potential safety or health risks that may need special protection measures during drilling, or that may require specific protective well construction measures.

Once the geologic analysis is completed, the BLM would review the company's proposed casing and cementing programs to ensure the well construction design is adequate to protect the surface and subsurface environment, including potential risks identified by the geologist and all known or anticipated zones with potential risks.

During drilling, the BLM would be on location during the setting of critical casing and cementing intervals. Before hydraulic fracturing takes place, all surface casings and some deeper, intermediate zones are 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 is run on certain strings of casing to ensure the cement has bonded to the casing and the formation.

During operation, the proposed pipelines could potentially leak or rupture, which could impact groundwater quality. The proposed pipelines would be tested to ensure integrity prior to operation. Cathodic protection systems would be installed to protect the pipelines from corrosion, which could

affect the integrity of the pipe. Potential impacts to groundwater quality from leaks or ruptures during pipeline operation would be long term.

Cumulative Impacts

Reasonably foreseeable development within the Largo sub-watershed may include an estimated additional 1,811 oil and gas wells and related facilities. Surface-disturbing activities that would be associated with these actions may affect an estimated 6,756 acres (USDI/BLM 2003a, page 4-7). The PRMP/FEIS determined that the primary cumulative impacts on water quality would result from surface disturbance, which would generate increased sediment yields (USDI/BLM 2003a, pages 4-123 and 4-124). Cumulative effects to water resources from the proposed action would be maximized shortly after construction begins and would decrease over time as reclamation efforts progress.

The proposed action would cumulatively contribute approximately 20.0 acres of long-term disturbance in the watershed. Cumulative impacts to surface waters would be related to short-term sedimentation or flow changes. Surface-disturbing activities other than the proposed action that may cause accelerated erosion include—but are not limited to—construction of roads, other facilities, and installation of trenches for utilities; road maintenance such as grading or ditch cleaning; public recreational activities; vegetation manipulation and management activities; prescribed and natural fires; and livestock grazing.

3.3 Soils

3.3.1 Affected Environment

Surficial geology in the analysis area is composed of the San Jose Formation. The Natural Resources Conservation Service classifies six different soil-mapping units within the analysis area: (1) Pinavetes-Florita complex, 2 to 10 percent slopes; (2) Sparank-San Mateo silt loams, saline, sodic, 0 to 3 percent slopes; (3) Orlie fine sandy loam, 1 to 8 percent slopes; (4) Vessilla-Menefee-Orlie complex, 1 to 30 percent slopes; (5) Rock outcrop-Vessilla-Menefee complex, 15 to 45 percent slopes; and (6) Sparank clay loam, moderately saline, sodic, 0 to 1 percent slopes (USDA/NRCS 1987; USDA/SCS 1980).

The San Jose Formation of Eocene age overlies the Nacimiento and the Animas Formations and consists of inter-bedded sandstone, shale, and variegated shale. The sandstones are fine- to coarse-grained, arkosic, sporadically conglomeratic, and contain silicified wood (Fassett 1974).

The Pinavetes-Florita complex is found on 2 to 10 percent sloping hills and toeslopes of hills. This soil is classified as deep and well drained with a moderately rapid permeability. Available water capacity is low to moderate and runoff is slow to medium. The potential for wind and water erosion is moderate to severe. The major limitations of this mapping unit are the hazard of water erosion, blowing soil and permeability (USDA/SCS 1980).

The Sparank-San Mateo complex, 0 to 3 percent slopes, is saline, alkaline, and sodic, and is found in the floodplains of broad valleys, with small areas of well- to excessively-drained soils on footslopes and toeslopes. The major limitations of this mapping unit are the hazard of water erosion, blowing soil, and

shrink-swell potential. The road construction rating for this soil complex is moderate to severe due primarily to the shrink-swell potential (USDA/SCS 1980).

Orlie fine sandy loam, 1 to 8 percent slopes, is found on broad valley side slopes. It is alluvial and eolian in origin and derived from shale and sandstone. This soil is very deep and well drained, and permeability is moderately slow. Available water capacity is high to very high. Runoff is medium, and the hazard of water erosion is moderate to severe. The hazard of soil blowing is moderately high. The shrink/swell potential of this soil is moderate (USDA/SCS 1980).

The Vessilla-Menefee-Orlie complex, 1 to 30 percent slopes, is found on mesas and plateaus. Vessilla sandy loam is found on breaks and hillsides. This soil is shallow, well drained and derived from sandstone. Permeability of the Vessilla soil is moderately rapid. Available water capacity is very low. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is severe. The Menefee soil is shallow and well drained and was formed in colluvium from shale. Permeability of the Menefee soil is slow. Available water capacity is very low. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is severe. Orlie soil is deep and well drained. It is alluvial in origin, derived from shale and sandstone. Permeability of the Orlie soil is moderately slow. Available water capacity is very high. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is slight. The shrink/swell potential of this soil is moderate (USDA/SCS 1980).

The Rock outcrop-Vessilla-Menefee complex, 15 to 45 percent slopes, is typically well drained with a slow permeability. Available water capacity is very low with a rapid surface runoff. The hazard of water and wind erosion is severe. The major limitations of this soil unit are soil depth, the hazards of water and wind erosion and slope. Therefore, this soil type has a severe road rating (USDA/SCS 1980).

Sparank clay loam, 0 to 1 percent slopes, is saline, alkaline, and sodic, and is found in the floodplains of broad valleys. This soil is deep and well drained. Permeability is very slow with available water capacity moderate. Runoff is slow and shrink-swell potential is high. The potential for water or wind erosion is moderate (USDA/SCS 1980).

3.3.2 Impacts from the Proposed Action

Direct and Indirect Impacts

The proposed action would impact approximately 77.5 acres of soils. Construction would result in temporary displacement, compaction, and mixing of soils. The well pads and new access roads (approximately 20.0 acres) would remain as bare, compacted soil for the life of the project (approximately 30 years) and would be subject to an undetermined amount of wind and water erosion until the wells and roads are completely reclaimed. Compaction of the soils during construction and operation of the proposed project, coupled with implementation of design features described below, would limit soil impacts from erosion. Soils are most susceptible to erosion during construction, when strong winds or precipitation events during soil-disturbing activities could mobilize soils. The impact on soils would be localized and short to long term.

Industry-related vehicle and pedestrian traffic would be restricted to proposed disturbance areas and existing roads. Following construction activities, unused areas would be reseeded with the BLM-approved seed mixes to stabilize soils and prevent erosion. Following construction, vehicle traffic would be restricted to existing bladed roads to prevent erosion, soil mixing, and compaction in adjacent areas. Proper soil salvage, storage, and reclamation will allow adequate infiltration and permeability rates and maintain soil moisture, which is necessary for plant growth and vigor, and minimize surface runoff.

Cumulative Impacts

The proposed action falls within the development that was assessed in the 2003 RMP EIS cumulative impacts analysis. The PRMP/FEIS determined that "cumulative impacts on soils in the San Juan Basin would comprise the total amount of short- and long-term surface disturbance due to all new oil and gas development and other activities" (USDI/BLM 2003a, page 4-123). The PRMP/FEIS projected that 6,756 acres of initial surface disturbance would occur in the Largo sub-watershed (USDI/BLM 2003a, page 4-7).

Past, present, and future developments are expected to result in a range of short- and long-term impacts to soils including disturbance, temporary or permanent increases in erosion prior to reclamation, and reduction of soil loss to erosion where reclamation and re-vegetation occurs. Given that about 20.0 acres of soil would be disturbed by the proposed action in the long term and the large extent that these soil types occur in the San Juan Basin, any impact from the proposed action is not expected to contribute appreciably to cumulative impacts to soils when added to past, present, and reasonably foreseeable actions.

3.4 Upland Vegetation and Noxious Weeds

3.4.1 Affected Environment

The analysis area is located within the Arizona/New Mexico Plateau eco-region and is further classified as San Juan/Chaco Tablelands and Mesas (Griffith et al. 2006). One vegetation community type occurs within the analysis area—Great Basin desert scrub sagebrush series (Dick-Peddie 1993). Approximately 15 acres of existing disturbance associated with roads and pipeline corridors occurs within the analysis area.

The analysis area is located in a Great Basin desert scrub sagebrush series community. Dominant species observed include blue grama (*Bouteloua gracilis*), big sagebrush (*Artemisia tridentata*), alkali sacaton (*Sporobolus airoides*), and broom snakeweed (*Gutierrezia sarothrae*). Approximately 50 percent of the big sagebrush located in the proposed Lybrook I14-2306 footprint was desiccated. Piñon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) trees ranging from 8 to 15 feet tall are located on toeslopes and ridges in the analysis area. Table 3-8 lists the project components with the estimated percent vegetation cover, number of trees, and presence of noxious weeds observed during the biological surveys in the analysis area.

Table 3-8. Percent vegetation cover, number of trees, and noxious weeds present in the analysis area

Component	Vegetation Cover (%)	Number of Trees	Noxious Weeds
Lybrook E13-2306	20-30	0	None
Lybrook I14-2306	25-40	45	None
Gallo Canyon Unit M14-2306	30-40	35	None
Gallo Canyon Unit M15-2306	20-35	13	None
Gallo Canyon Unit O15-2306	50	21	None
Gallo Canyon Unit P14-2306	40	75	None
Gallo Canyon Unit North Access Road	20-30	0	None
Gallo Canyon Unit North Trunk Pipeline	5-25	40	None

3.4.2 Impacts from the Proposed Action

Direct and Indirect Impacts

Direct impacts would include removal of vegetation during site-clearing activities. Construction of the proposed action would result in the removal and modification of approximately 62.6 acres of undisturbed vegetation including an estimated 229 piñon pine and Utah juniper trees. Potential impacts include changes in species composition and density, and an increased potential for invasive species to establish. Following reclamation, there would be long-term changes in the density and composition of analysis area vegetation communities. Trees may not re-establish in the area for several decades. Disturbed areas would be expected to re-vegetate in 2 or more years. There would be a long-term loss of approximately 20.0 acres of desert scrub vegetation for well access and operation.

No state- or BLM-listed noxious weed species were observed in the analysis area during field visits. Invasive species are generally tolerant of disturbed conditions, and disturbed soils at project sites may provide an opportunity for the introduction and establishment of non-native invasive species. During construction and operation, noxious weed sources could be introduced to disturbed areas from vehicles, equipment, people, wind, water, or other mechanisms. There would be a long-term potential for noxious weeds to establish in the area. Encana would be responsible for monitoring and controlling any noxious weed species within the ROWs and well pads for the life of the project.

Re-vegetation of well pad construction zones and the pipeline ROWs would be initiated by Encana within 120 days of well completion and pipeline construction. All vegetation removed during site-clearing activities would be mowed and incorporated into stockpiled topsoil. Trees that are 3 inches or greater in diameter would be cut and de-limbed. The area would be reseeded the BLM Sagebrush-Grass Community seed mix.

Cumulative Impacts

Within the BLM/FFO planning area, there are approximately 435,500 acres of Great Basin desert scrub (USDI/BLM 2003a, page 3-31). Based on the acres this community type within the planning area and the estimated total disturbance of future activities, approximately 2.7 percent of Great Basin desert scrub communities would be disturbed within the planning area over 20 years from reasonably foreseeable future actions (USDI/BLM 2003a, page 3-31 and 4-7). The proposed action would cumulatively contribute 20.0 acres of long-term vegetative disturbance in the planning area.

3.5 Wildlife

3.5.1 Affected Environment

The proposed action is not located within a BLM wildlife specially designated area (SDA). There are no unique habitats within the analysis area. The analysis area is dominated by a Great Basin desert scrub vegetation community. Wildlife common to this habitat include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), fox (*Vulpes* sp.), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and reptiles (snakes and lizards). Coyote (*Canis latrans*), mule deer, elk, black-tailed jackrabbit, desert cottontail, kangaroo rat (*Dipodomys* spp.), and woodrat (*Neotoma* sp.) sign (burrows, tracks, scat) were observed during the biological surveys.

3.5.2 Impacts from the Proposed Action

Direct and Indirect Impacts

Two parameters are considered when evaluating habitat loss—direct habitat loss and effective habitat loss. Direct habitat loss occurs through the removal of vegetation, which reduces the extent or quality of habitat in terms of food and cover. Vegetation removal strips the affected area of its value to wildlife; therefore, direct habitat loss can be quantified by comparing the area of habitat lost to the amount retained. The amount of habitat available to wildlife is called effective habitat. The effectiveness of habitat is lost when a species reduces use or avoids an area. Loss of effective habitat area can exceed direct habitat loss. Effective habitat loss can occur from habitat fragmentation, disturbance, and interference with movement. The impacts of habitat fragmentation are related to the loss of large contiguous areas of habitat and the relative increase in habitat “edge” in smaller areas. Construction of roads and other development, as well as human and vehicular traffic on existing roads, can cause habitat fragmentation. Such disturbance can cause animals to shift their activity or alter their behavior.

The proposed action would result in the removal and modification of approximately 62.6 acres of undisturbed vegetation including removal of an estimated 229 piñon and juniper trees of varying ages and sizes that are widely scattered within the analysis area. Vegetation communities within the proposed analysis area provide forage for big game and forage and cover for other wildlife species. Since the vegetation removed would not be replaced with the same species and because the removal of vegetation in previously undisturbed areas would result in habitat fragmentation, an alteration of

available wildlife habitat and utilization is anticipated. Impacts to wildlife habitat would include short-term loss of natural vegetation and changes in composition of vegetation. The majority of direct habitat loss would be short term, as areas reclaimed would recover their value as wildlife habitat. However, there would be a long-term loss of approximately 20.0 acres for well operation and access. Most species observed or expected to inhabit the area are generalists and would be minimally affected by the changes in vegetation composition.

Mule deer and elk have been shown to avoid natural gas wells, roads, and areas immediately surrounding them, resulting in a loss of effective habitat. Hebblewhite summarized that the average zone of influence reported in eight different studies extended about 1,000 meters (3,281 feet) from roads and wells. The nature and extent of this avoidance is dependent upon the type of vegetation—particularly the amount of cover present, topography, the volume of traffic, and whether or not vehicles stop or continue moving; however, responses varied within seasons and among species (2011). Disturbance is a primary factor in effective habitat loss as it can alter the ways wildlife use or move through an area and could push individual animals from preferred habitat into less suitable habitat. Such displacement would likely be localized around the source of the disturbance (i.e., equipment noise, human presence, etc.). Data collected by the BLM and New Mexico Department of Game and Fish in the Rosa Wildlife SDA between 1994 and 2012 indicate a positive correlation between the increasing number of gas wells and accompanying roads and the decline in mule deer fawn to doe ratios.

Since there is so much variability between studies, and no studies specific to the BLM/FFO have been completed, a conservative buffer of 400 meters (1,312 feet) was selected to quantify the potential effective habitat loss resulting from the proposed action. Based on a 400 meter buffer of the proposed action, indirect wildlife habitat loss would affect approximately 1,276 acres. Avoidance by wildlife would depend on the species, time of day, time of year, human activity level, topography, and cover type. It should also be noted that the zone of influence around roads and well pads does not imply 100 percent avoidance (Hebblewhite 2011). Impacts from effective habitat loss would be greatest during construction and drilling and would decrease over time in correlation to human and vehicular activity levels.

During construction, drilling, and completion, there would be short-term impacts to area wildlife because of human and vehicular activity and associated noise. Wildlife in the area would be displaced to adjacent habitat or may temporarily avoid the area during construction activities. Once the project is complete, wildlife would likely return to the area. It is possible that small wildlife, particularly burrowing species, may be killed during construction. During operation, the level of human and vehicular activity in the analysis area would decrease substantially. However, one light-duty vehicle would continue to access the area on near daily basis. Heavy-duty vehicles (semi-trucks) would access the well sites 1 to 2 times a day for approximately 6 months, after which traffic trips would decrease to approximately 1 trip per month. Long-term impacts from vehicle traffic on roads could include incidental mortality to wildlife. Animal-vehicle collisions are variable depending on the time of day, speed and volume of traffic, local topography, structural features of the road, and the size and behavior of the individual species. The proposed access roads would also facilitate entry to areas not previously open to vehicular travel, potentially resulting in increases in legal and illegal hunting.

Wildlife could come into contact with chemicals or fluids stored on-site. Use of a closed-loop system would minimize potential impacts to wildlife from exposure to chemicals or fluids during drilling and completion. During operation, any open pits would be netted and vent caps placed on all open pipes to prevent bird entry and nesting. Any spills would be promptly cleaned up, and Encana maintains an emergency response plan. All chemicals or fluids stored on-site would be properly contained and would have secondary containment.

Construction activities would be confined to the permitted area to avoid further disruption to wildlife. Re-vegetation would be initiated immediately following construction or at the direction of the BLM/FFO. Gaps would be made, as needed, in topsoil or subsoil stockpiles to allow for wildlife crossings and to avoid ponding or excessive diversion of natural runoff during storm events. Trenches would be inspected for wildlife prior to laying pipe and back filling; trenches would not be left open more than 24 hours. Adherence to BLM reclamation and sanitation measures would also minimize potential impacts to wildlife.

Cumulative Impacts

Reasonably foreseeable development within the Largo sub-watershed may include an estimated additional 1,811 oil and gas wells and related facilities, and 147 miles of new roads. Surface-disturbing activities that would be associated with these actions may affect an estimated 6,756 acres of wildlife habitat (USDI/BLM 2003a, page 4-7 and 4-8). Other reasonably foreseeable actions such as continued livestock grazing, vegetation treatments, and community development would cumulatively impact wildlife through direct and effective habitat loss. The proposed action would cumulatively contribute approximately 20.0 acres of habitat loss in the long term and up to approximately 1.276 acres of effective wildlife habitat loss in the planning area. The proposed action would contribute to cumulative habitat fragmentation within the planning area from the construction of approximately 2.7 miles of new road.

3.6 Special Management Species

3.6.1 Affected Environment

In accordance with BLM Manual 6840, the BLM manages certain sensitive species not federally listed as threatened or endangered in order to prevent or reduce the need to list the species as threatened or endangered in the future. There are also state-listed threatened or endangered species with potential to occur in Rio Arriba and Sandoval Counties, New Mexico. Table 3-9 lists the special management species that have the potential to occur in the analysis area. A Biological Survey Report for each proposed well pad project was prepared and is provided in Appendix C. The Biological Survey Reports provide the basis for the findings listed in Table 3-9.

None of the special status species with the potential to occur in the analysis area were observed during the biological surveys.

Table 3-9. Special status species with potential to occur in the analysis area

Species	Conservation Status	Habitat Associations
Mammals		
Spotted bat (*Euderma maculatum*)	State Threatened; BLM Sensitive	The preferred habitat is meadows in subalpine coniferous forest. Also recorded in a wide variety of habitats, from riparian, Great Basin desert shrub, and piñon-juniper woodlands to ponderosa. Rocky cliffs are important for roosting. Permanent water sources are important for foraging.
Townsend's big-eared bat (*Corynorhinus townsendii*)	BLM Sensitive	Roosts mostly in caves or mines; at night can roost in abandoned buildings. Will also use rock crevices and hollow trees as roost sites. In summer, this species occurs widely across the state and can be found over desert-scrub, desert-mountains, oak-woodland, piñon-juniper, and coniferous forests.
Birds		
American peregrine falcon (*Falco peregrinus anatum*)	State Threatened; BLM Sensitive	The breeding territories of peregrine falcons in New Mexico center on cliffs in wooded/forested habitats, with large "gulfs" of air nearby in which these predators can forage.
Bendire's thrasher (*Toxostoma bendirei*)	BLM Sensitive	Typically inhabits sparse desert shrubland and open woodland with scattered shrubs or trees.
Chestnut-collared longspur (*Calcarius ornatus*)	BLM Sensitive	A native prairie specialist that winters in grasslands, deserts, and plateaus dominated by low grasses and forbs, where most vegetation is less than 1.5 feet high.
Golden eagle (*Aquila chrysaetos*)	BLM Sensitive	In the western United States, mostly open habitats in mountainous, canyon terrain, nests primarily on cliffs.
Gray vireo *(Vireo vicinior)*	State Endangered	Mixed piñon-juniper, juniper sagebrush associations, and dry brushland with oak scrub woodlands.
Piñon jay *(Gymnorhinus cyanocephalus)*	BLM Sensitive	Primarily associated with piñon-juniper habitat.
Prairie falcon (*Falco mexicanus*)	BLM Sensitive	Arid, open regions of grassland or scrub vegetation with cliff formations that high and inaccessible. Breeding cliffs are sometimes in semi-open regions with scattered conifer trees and occasionally dense woodlands.

Sources: USDI/BLM 2008b; BISON-M 2014; NHNM 2014

3.6.2 Impacts from the Proposed Action

Direct and Indirect Impacts

The analysis area provides potential foraging habitat for spotted bat and Townsend's big-eared bat. No potential roosting habitat would be removed by the proposed action. Impacts to these bat species

would be limited to avoidance of the area during nighttime drilling activities when they may incidentally forage in the area. These impacts would be short term and limited to summer months when the species could be in the analysis area.

The analysis area provides suitable nesting habitat for Bendire's thrasher (*Toxostoma bendirei*). The proposed action would result in modification of approximately 62.6 acres of undisturbed habitat and the long-term loss of approximately 20.0 acres. Should construction and drilling occur during the breeding season, Bendire's thrasher would likely avoid the area. Pre-construction surveys would be conducted to identify any active nests within the proposed disturbance area if construction should occur between May 15 and July 31. This design feature would avoid or minimize impacts to Bendire's thrasher.

The project area provides suitable wintering habitat for chestnut-collared longspur (*Calcarius ornatus)*. Impacts to chestnut-collared longspur would include avoidance of the area during construction and drilling if it occurs during the winter months and the long-term loss of 20.0 acres of suitable wintering habitat.

The analysis area contains open desert scrub, providing potential foraging habitat for golden eagle, American peregrine falcon, and prairie falcon. No potential nesting habitat for these species would be removed or modified by the proposed action. No raptor nests were identified within a 1/3-mile radius of the analysis area. Direct impacts would include the modification of approximately 62.6 acres of undisturbed foraging habitat. Approximately 229 piñon and juniper trees of various ages and sizes would be removed by the proposed action, resulting in a long-term loss of potential perch sites. This loss of perch habitat is not expected to adversely affect the foraging abilities of these raptor species, given the abundance of suitable sites in the surrounding area. After reclamation, there would be a short- to long-term change in vegetation density and composition. This could affect the prey base for these raptors. Approximately 20.0 acres of potential foraging habitat would be converted to industrial use in the long term. Raptors may avoid the analysis area during construction, drilling, and operation due to disturbance and activity from human and vehicle presence and associated noise.

Cumulative Impacts

The BLM/FFO would continue to manage non-federally listed species according to BLM policies and guidelines, with the goal of contributing to the conservation of these species to reduce the potential for being listed under the Endangered Species Act (ESA) of 1973, as amended (USDI/BLM 2003a, 4-111). For reasonably foreseeable actions on federal lands, direct impacts to nesting special status raptor species would be avoided through the BLM's siting criteria. Development on federal and private lands would result in the removal or modification of potential foraging habitat. These effects would be related to availability of undisturbed habitat and the amount of disturbance that would occur within the analysis area.

The PRMP/FEIS determined that up to 5.5 percent (128,000 acres) of vegetation in the planning area could be impacted cumulatively by oil and gas development (USDI/BLM 2003a, page 4-125). Other reasonably foreseeable actions within the planning area that could impact special status species would include livestock grazing, agriculture, commercial and residential development, mining, and vegetation

management. The proposed action would not contribute appreciably to a cumulative habitat loss for BLM special management species within the planning area.

3.7 Migratory Birds

3.7.1 Affected Environment

Under the Migratory Bird Treaty Act and Executive Order 13186, federal agencies are required to consider impacts to migratory birds from management activities. The BLM migratory bird conservation policy for the planning area is detailed in Instruction Memorandum No. NM-F00-2010-001 (USDI/BLM 2010). This management policy establishes a consistent approach for addressing migratory bird populations and habitats when by making project level implementation decisions. The management policy also outlines best management practices and design features to avoid or minimize impacts.

While all migratory songbirds are protected by law, certain species have been determined to be at greater risk than others. More than 350 avian species occur in San Juan County and the surrounding area administered by the BLM/FFO. Data collected through breeding bird surveys coordinated by the USFWS and private sector efforts have provided the basis for the New Mexico Partners in Flight (NMPIF) organization to develop bird "watch lists" and the USFWS list of Birds of Conservation Concern. The NMPIF has also identified priority species of birds by habitat type for the state of New Mexico. The FFO area lies within the Colorado Plateau physiographic region, as identified by the NMPIF. The analysis area contains the Great Basin desert shrub (sage-grass) habitat.

The Bird Conservation Plan developed for the State of New Mexico by the NMPIF lists the sage thrasher (*Oreoscoptes montanus*) and sage sparrow (*Amphispiza belli*) as a "highest priority" species for conservation in the Great Basin desert shrub habitat. Most of the priority bird species identified by the NMPIF also occur on the USFWS Division of Migratory Bird Management list of "Birds of Conservation Concern 2008" within the Bird Conservation Region 16–Southern Rockies/Colorado Plateau. Birds included on this list are those "species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973" (USFWS 2008).

No nests were recorded within the analysis area during the biological surveys.

3.7.2 Impacts from Proposed Action

Direct and Indirect Impacts

Executive Order 13186 calls for increased efforts to fully implement the Migratory Bird Treaty Act. In keeping with this mandate, the BLM consulted the NMPIF Bird Conservation Plan for the State of New Mexico and the USFWS list of Birds of Conservation Concern. A review of these documents—specifically as they pertain to the Colorado Plateau physiographic area—indicates there are eight "priority" avian

species with a known range of distribution in the BLM/FFO planning areas that utilize the sage-grass habitat within the Great Basin desert shrub habitat.

Various types of perturbations and/or anthropogenic activity may affect these species. These species and a brief assessment of the effects of the proposed action on their habitat are provided in Table 3-10.

Table 3-10. Migratory bird species of concern potentially occurring within the analysis area and effects from the proposed action

Species	Habitat Type	Effects
Grasshopper sparrow (*Ammodramus savannarum*)	Sage-grass	May be positively affected due conversion to grassland
Sage sparrow[1] (*Amphispiza belli*)	Sage-grass	May be positively affected due conversion to grassland
Burrowing owl (*Athene cunicularia*)	Sage-grass	No effect; nests in abandoned prairie dog burrows
Ferruginous hawk (*Buteo regalis*)	Sage-grass/piñon-juniper interface	No effect; no suitable habitat in the analysis area
Mountain plover (*Charadrius montanus*)	Sage-grass	No effect; no suitable habitat in the analysis area
Long-billed curlew (*Numenius americanus*)	Sage-grass	May be positively affected due to conversion to grassland
Sage thrasher[1] (*Oreoscoptes montanus*)	Sage-grass	May be positively affected due to conversion to grassland
Bendire's thrasher (*Toxostoma bendirei*)	Sage-grass	May be positively affected due to conversion to grassland

[1] "High Priority" bird species that are on the NMPIF Priority Species List, but not on the USFWS Birds of Conservation Concern 2008 list. Source: NMPIF 2007.

Direct impacts to migratory birds would include the disturbance and modification of approximately 62.6 acres of undisturbed desert scrub vegetation. There would be a long-term loss of approximately 20.0 acres of habitat that would be converted to an industrial use. Migratory birds would be impacted by disturbance during construction, drilling, and completion; these impacts would be short term. During production, impacts to migratory birds would be related to an increase in habitat fragmentation and disturbance from periodic traffic for maintenance and fluid removal.

Impacts to migratory birds would be greater should construction occur during the breeding season of May 15 through July 31. Construction, drilling, and completions during this period could result in nest destruction or may cause some nest abandonment in adjacent areas. Pre-construction surveys would be conducted to identify any active nests should construction occur during the breeding season. Migratory birds could come into contact with chemicals or fluids stored on-site. Open pits will be netted and vent caps placed on all open pipes to prevent bird entry and nesting. Any spills would be promptly cleaned up. Although individual migratory birds could be impacted by the proposed action, no population level impacts are expected.

Cumulative Impacts

Other reasonably foreseeable actions within the planning area that could impact migratory birds would include livestock grazing, agriculture, commercial and residential development, mining, wildfire, and vegetation management. Cumulative impacts to migratory birds from the proposed action would result from the long-term changes in density and composition of approximately 20.0 acres of Great Basin desert scrub habitat. The proposed action would contribute to cumulative habitat fragmentation within the planning area from the construction of approximately 2.7 miles of new road. The proposed action would contribute negligible impacts to migratory birds when combined with past, present, and future actions.

3.8 Cultural Resources

3.8.1 Affected Environment

The proposed analysis area is located within the archaeologically rich San Juan Basin of northwestern New Mexico. In general, the prehistory of the San Juan Basin can be divided into five major periods: PaleoIndian (ca. 10000 B.C. to 5500 B.C.), Archaic (ca. 5500 B.C. to A.D. 400), Basketmaker II-III and Pueblo I-IV periods (A.D. 1 to 1540), and the historic (A.D. 1540 to present) that includes Native American as well as later Hispanic and Euro-American settlers. A detailed description of these various periods and select phases within each period is provided in the Farmington PRMP/FEIS (USDI/BLM 2003a).

The entire area of potential effect for the proposed action was archaeologically surveyed by LAC at a BLM Class III level (100 percent). Reports were prepared and submitted to the BLM in accordance with the *Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities* (USDI/BLM 2005). The cultural resource survey results are included in three reports (LAC Report 2013-6p, LAC Report 2013-6z, and LAC Report 2012-36; BLM 2014(IV)025F, 2014(IV)031F, 2014(IV)044F).

Prior to all field surveys of the proposed action, a Class I investigation of records at the BLM/FFO and an online search of Archeological Records Management Services was conducted to determine if any sites have been recorded within 0.25 or 0.5 mile of the survey area.

The LAC Report 2013-6p includes the proposed Lybrook E13-2306, Lybrook I14-2306, Gallo Canyon Unit M14-2306, Gallo Canyon Unit P14-2306, Gallo Canyon Unit O15-2306 well pads, associated well-tie pipelines and access roads. This includes the Gallo Canyon Unit North Access Road as part of the Lybrook E13-2306. The abandoned Gallo Canyon Unit P15-2306 well location was also included in this report. There are 16 previously recorded sites occurring within 0.5 mile of these proposed project locations. There were eight new sites and 14 isolated occurrences encountered during the cultural surveys. Three of the previously recorded sites (LA 85430, LA 85431, LA 85871) and two of the new sites (LA 178915 and LA 178916) are associated with the proposed Gallo Canyon Unit M14-2306 well pad and well-tie pipeline. The remaining previously recorded sites are located 1,000 feet or more from the proposed

project area. One new site (LA 178913) is located along the proposed Lybrook E13-2306 well-tie pipeline, one site (LA 178914) is located along the proposed Gallo Canyon Unit P14-2306 well-tie pipeline, and two new sites (LA 178919 and LA 178920) are associated with the proposed Gallo Canyon Unit O15-2306 well pad. Two of the new sites (LA 178917 and LA 178918) are associated with the abandoned Gallo Canyon Unit P15-2306. Six sites in the project area (LA 85430, LA 178914, LA 178915, LA 178916, LA 178917, and LA 178919) are recommended as eligible for nomination to the National Register of Historic Places (National Register). The previously recorded site LA 85871 has been officially determined as eligible for the National Register. Additional data is needed for sites LA 85431 and LA 178918 before a recommendation can be made. The remaining sites (LA 178913 and LA 178920) are recommended as ineligible for nomination to the National Register.

The LAC Report 2013-6z includes the proposed Gallo Canyon Unit M15-2306 well pad, associated well-tie pipeline and access road. There are seven previously recorded sites occurring within 0.25 mile of the proposed project. Two of these sites (LA 66590 and LA 66591) are located within 400 feet of the project area. No new sites were encountered during the cultural surveys.

The LAC Report 2012-36 includes the proposed Gallo Canyon Unit North Trunk pipeline. There are four previously recorded sites occurring within 0.25 mile of the proposed project. One site (LA 149204) was located within 500 feet of the project area. This site was relocated and the east and northeast site boundaries were reestablished. No new sites were encountered during the cultural surveys.

For the proposed action, identification of Native American religious concerns included reviewing existing, published, and unpublished literature (Brugge 1993; Kelly et al. 2006; Van Valkenburgh 1941, 1974); the site-specific Class III survey reports prepared for the proposed action; and a review by the BLM's cultural resources program regarding the presence of traditional cultural properties identified through ongoing BLM tribal consultation efforts.

The BLM/FFO consulted with the Navajo Nation Historic Preservation Department (NNHPD) concerning a traditional cultural property (TCP) that occurs in the analysis area. The NNHPD indicated that the TCP would not be affected by the proposed action (Haymes 2014).

3.8.2 Impacts from the Proposed Action

Direct and Indirect Impacts

Direct impacts normally include alterations to the physical integrity of a cultural site. If a cultural site is significant for other than its scientific information, direct impacts may also include the introduction of audible, atmospheric, or visual elements that are out of character for the cultural site. A potential indirect impact from the proposed action is the increase in human activity or access to the area with the increased potential of unauthorized removal or other alteration to cultural sites in the area.

Significant cultural sites (e.g., National Register eligible/listed) are being avoided with the implementation of design features, such as but not limited to, reduction of construction areas, temporary barriers, and site monitoring. These design features are detailed in the BLM Cultural

Resource Record of Review, attached to the COA in the APDs and ROW grants. The proposed action is not known to physically threaten any traditional cultural property, prevent access to sacred sites, prevent the possession of sacred objects, or interfere or otherwise hinder the performance of traditional ceremonies/rituals. The proposed action would have no direct or indirect impact on significant cultural sites.

Cumulative Impacts

The proposed action would have no negative cumulative impact on cultural resources, as significant cultural sites would be avoided. A positive cumulative effect is the additional scientific information yielded by the archaeological surveys.

3.9 Livestock Grazing

3.9.1 Affected Environment

There are 208 grazing allotments managed by the FFO with approximately 390 grazing authorizations that permit primarily cattle and sheep grazing within in the FFO boundaries. A very limited number of these allotments also permit goats and occasionally horses for ranch use only. Allotments range in size from approximately 20 to over 100,000 acres. For all 208 allotments, the FFO permits a total of approximately 119,162 active animal unit months (AUMs), of which approximately 9,228 are Navajo Free Use. Under the Taylor Grazing Act of 1937, allotments can be permitted through Section 3 (permits issued on public lands within grazing districts established by the Act) or Section 15 (grazing leases issued on public lands outside the grazing districts established by the Act). Of the 208 FFO grazing allotments, 143 are Section 3 allotments and 65 are Section 15 allotments. There are approximately 325 authorizations on Section 3 allotments, of which 3 are very large Navajo community allotments. There are 65 authorizations on the Section 15 allotments. For the Section 15 allotments, 30 are administered by the Bureau of Indian Affairs under a Memorandum of Understanding, 5 are managed under the Navajo Nation Tribal Ranches program, and 30 are located near Lindrith, New Mexico. There are an additional 21 allotments that are within or overlap the FFO boundary that are managed by the Rio Puerco Field Office (RPFO) through an interagency agreement. On these 21 allotments, the RPFO only administers the grazing; the FFO manages all other uses on these allotments.

The proposed action would be located within the boundaries of the Gallo Canyon (5124) and Rancho Largo (5119) grazing allotments. Both allotments are going through permit renewal. The Rancho Largo Allotment EA is complete (DOI-BLM-NM-F010-2013-0082). The renewal included defining the boundaries of the Crow Mesa Wildlife Area. The acres had been removed from grazing in the previous EA. The Gallo Canyon permit renewal EA is currently under review. No changes were made to either allotment from the previous 10 year renewal. Table 3-11 lists details of these allotments.

Table 3-11. Details of the grazing allotments in the analysis area

Allotment Number	Livestock Number	Livestock Type	Period Begin Date	Period End Date	AUM
5124	13	Cattle	03/01	02/28	115
5119	300	Cattle	06/01	12/31	1,752

AUM = Animal Unit Month

3.9.2 Impacts from the Proposed Action

Direct and Indirect Impacts

Surface disturbance associated with construction of the proposed action would remove approximately 62.6 acres of undisturbed vegetation, resulting in a reduction in forage and a change to the vegetative species composition. Approximately 69.8 acres in the Gallo Canyon allotment would be impacted and the remaining approximately 7.7 acres of disturbance would occur in the Rancho Largo allotment. Impacts to grazing resources would occur from the direct short-term loss of about 2 AUMs in the Gallo Canyon allotment and 0.3 AUM in the Rancho Largo allotment, at an estimated 25 acres per AUM. Reclaimed areas would be expected to re-vegetate within 1 to 2 years following reclamation. There would be a long-term loss of approximately 0.6 AUM in the Gallo Canyon allotment and 0.2 AUM in the Rancho Largo allotment. Reseeding of disturbed areas with the approved seed mix that is composed of grasses and palatable shrubs, may result in an increase in available forage within the affected allotments. This increase is not expected to be measurable.

Cattle may occur in the proposed analysis area, depending on the time of year. Livestock could also become trapped in the open trench and long sections of the open trench could present barriers to livestock movement. There would be a potential for livestock collisions with equipment and vehicles working in the area. However, livestock would be expected to avoid the area due to increased noise and activity. Gaps would be made as needed in topsoil or subsoil stockpiles to allow for livestock crossing. Pipeline trenches would be inspected for livestock prior to laying pipe and back filling; trenches would not be left open for more than 24 hours.

Livestock could come into contact with chemicals or fluids stored on-site. Use of a closed-loop system would minimize potential impacts to livestock from exposure to chemicals or fluids during drilling and completion. Any spills would be promptly cleaned up and Encana maintains an emergency response plan. All chemicals or fluids stored on-site would be properly contained and would have secondary containment.

Cumulative Impacts

Other reasonably foreseeable activities within the planning area that would impact forage resources include off-highway vehicle traffic, vegetation treatments, and grazing. The PRMP determined that total surface disturbance from oil and gas development in the planning area would affect about 1.6 percent of the San Juan Basin. Added to other surface disturbance from urban development, the overall effect of removing rangeland acreage from production would still be minimal when compared to the acreage of

available forage (USDI/BLM 2003a, pages 4-126 to 4-127). When added to past, present, and reasonable foreseeable activities within the grazing allotments, the proposed action would not result in measurable changes to the allotments carrying capacity or to available AUMs.

4. SUPPORTING INFORMATION

4.1 Tribes, Individuals, Organizations, or Agencies Consulted

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Kenneth Werito, Sr., Red Skies Surveying and Mapping, Inc.

Bud Kramme, Walsh Engineering and Production Corp.

James Cunningham, Scorpion Survey and Consulting, LLC

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4.3 References

Allen, D., A. Pacsi, D. Sullivan, D. Araiza, M. Harrison, and K. Keen. 2014. Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Pneumatic Controllers. *Environmental Science and Technology*, es5040156.

Allen, D., D. Sullivan, D. Araiza, A. Pacsi, M. Harrison, and K. Keen. (2014a). Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Liquid Unloadings. *Environmental Science and Technology*, es504015.

BISON-M. 2014. Biota Information System of New Mexico. Online at: http://bison-m.org. Accessed January 2014.

Brugge, D. M. 1993. An Investigation of AIRFA Concerns Relating to the Fruitland Coal Gas Development Area. Office of Contract Archaeology, University of New Mexico. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Dick-Peddie, W. A. 1993. New Mexico Vegetation: Past, Present, and Future. University of New Mexico Press. Albuquerque, New Mexico.

Fassett, J. E. 1974. Cretaceous and Tertiary Rocks of the Eastern San Juan Basin, New Mexico and Colorado. New Mexico Geol. Soc. Guidebook, 25th Field Conference. Ghost Range, New Mexico.

Griffith, G. E., J. M. Omernik, M. M. McGraw, G. Z. Jacobi, C. M. Canavan, T. S. Schrader, D. Mercer, R. Hill, and B. C. Moran. 2006. Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Haymes, G. 2014. Personal Communication with Geoffrey Haymes, Archaeologist, Bureau of Land Management Farmington Field office. Email dated December 5, 2014 referencing correspondence with Navajo Nation Historic Preservation Department on September 24, 2014.

Field Code Changed

Hebblewhite, M. 2011. Effect of Energy Development on Ungulates in Energy Development, editor David E. Naugle. Island Press, Washington, DC, USA.

Howarth, R., R. Santoro, and A. Ingraffea. 2011. Methane and the greenhouse-gas footprint of natural gas from shale formations. Climate Change, 679-690.

Kelly, K., R. Martin, R. Begay, T. Neff, and C. Werito. 2006. "We Will Help You With What We Know": Diné Traditional Cultural Places In Dinétah. Museum of Northern Arizona Environmental Solutions, Inc., Flagstaff. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Kort, E., C. Frankenberg, K. Costigan, R. Lindenmaier, M. Dubey, and D Wunch. 2014. Four Corners: The largest US methane anomaly viewed from space. Geophysical Research Letters, 6898-6903.

Natural Heritage New Mexico (NHNM). 2014. NHNM Species Information. NMBiotics Database. Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM. Available at http://nhnm.unm.edu. Accessed on December 3, 2012.

New Mexico Environment Department (NMED). 2010. Inventory of New Mexico Greenhouse Gas Emissions: 2000-2007. Available online at: http://www.nmenv.state.nm.us/cc/index.html.

New Mexico Partners in Flight (NMPIF). 2007. New Mexico Bird Conservation Plan Version 2.1. C. Rustay and S. Norris, compilers. Albuquerque, New Mexico.

New Mexico Office of the State Engineer (NMOSE). 2014. New Mexico Water Rights Reporting System.

Schneising, O., J. Burrows, R. Dickerson, M. Buchwitz, M. Reuter, and H. Bovensmann. 2014. Remote sensing of fugitive methane emissions from oil and gas production in North American tight geologic formations. Earth's Future, 548-558.

Stone, W. J., F. P. Lyford, P. F. Frenzel, N. H. Mizell, and E. T. Padgett. 1983. Hydrogeology and water resources of San Juan Basin, New Mexico: Socorro, New Mexico Bureau of Mines and Mineral Resources Hydrologic Report 6, 70 p.

U.S. Department of Agriculture /Natural Resources Conservation Service (USDA/NRCS). 1987. Soil Survey of Rio Arriba Area, New Mexico, Parts of Rio Arriba and Sandoval Counties. Prepared by the Natural Resources Conservation Service in cooperation with the United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs, and the New Mexico Agricultural Experiment Station.

U.S. Department of Agriculture /Soil Conservation Service USDA/SCS. 1980. Soil Survey of San Juan County, Eastern Part. Prepared by the Natural Resources Conservation Service in cooperation with the United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs, and the New Mexico Agricultural Experiment Station.

U.S. Department of the Interior, Bureau of Land Management (USDI/BLM). 2002. Biological Assessment: Impacts to threatened and endangered species related to the resource management plan. U.S.

Field Code Changed

Field Code Changed

Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2003a. Farmington proposed resource management plan and final environmental impact statement. U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2003b. Farmington resource management plan record of decision. U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico. U.S.

USDI/BLM. 2005. BLM Manual Supplement H-8100-1. Procedures for Performing Cultural Resources Fieldwork on Public Lands in the Area of New Mexico BLM Responsibilities. New Mexico, Oklahoma, and Texas.

USDI/BLM. 2008a. NEPA Handbook H 1790 1 [BLM 1/30/2008]. Washington, D.C.

USDI/BLM. 2008b. Special status species management. Instruction Memorandum No. NM-200-2008-001. Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2010. Instruction Memorandum No. NM-F00-2010-001. Migratory Bird Treaty Act—BLM/FFO Interim Management Policy. Bureau of Land Management, Farmington Field Office, Farmington, New Mexico.

USDI/BLM. 2014. Air Resources Technical Report for Oil and Gas Development. New Mexico, Oklahoma, Texas, and Kansas. Bureau of Land Management, New Mexico State office. Santa Fe, New Mexico.

U.S. Department of the Interior and United States Department of Agriculture (USDI/USDA). 2007. Surface and Operating Standards and Guidelines for Oil and Gas Exploration and Development. BLM/WO/ST-06/021+0371/REV 07. Denver, Colorado. 84 pp.

U.S. Environmental Protection Agency (USEPA). 2004. Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reserves. Office of Ground Water and Drinking Water (4606M). EPA 816-R-04-003.

USEPA. 2012. 2005 National-Scale Air Toxics Assessment. Retrieved February 27, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/ttn/atw/nata2005/.

USEPA. 2013a. The Green Book Nonattainment Areas for Criteria Pollutants. Retrieved February 25, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/airquality/greenbook/.

USEPA. 2013b. Air Quality Index Report. Accessed March 12, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/airdata/ad_rep_aqi.html.

Field Code Changed

Field Code Changed

Field Code Changed

USEPA. 2014. Air Trends: Design Values. Accessed February 25, 2014, from U.S. Environmental Protection Agency. Available at http://www.epa.gov/airtrends/values.html.

U.S. Fish and Wildlife Service (USFWS). 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. [Online version available at http://www.fws.gov/migratorybirds/].

Van Valkenburgh, Richard F. Van. 1941. Diné Bikeyah. Department of the Interior, Office of Indian Affairs, Navajo Services, Window Rock. Ms. on file, Bureau of Land Management, Farmington, New Mexico.

Van Valkenburgh, R. F. 1974. Navajo Sacred Places, ed. Clyde Kluckhohn. In Navajo Indians III, pp. 9-199. Garland Publishing. New York.

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Appendix A – Maps and Photographs

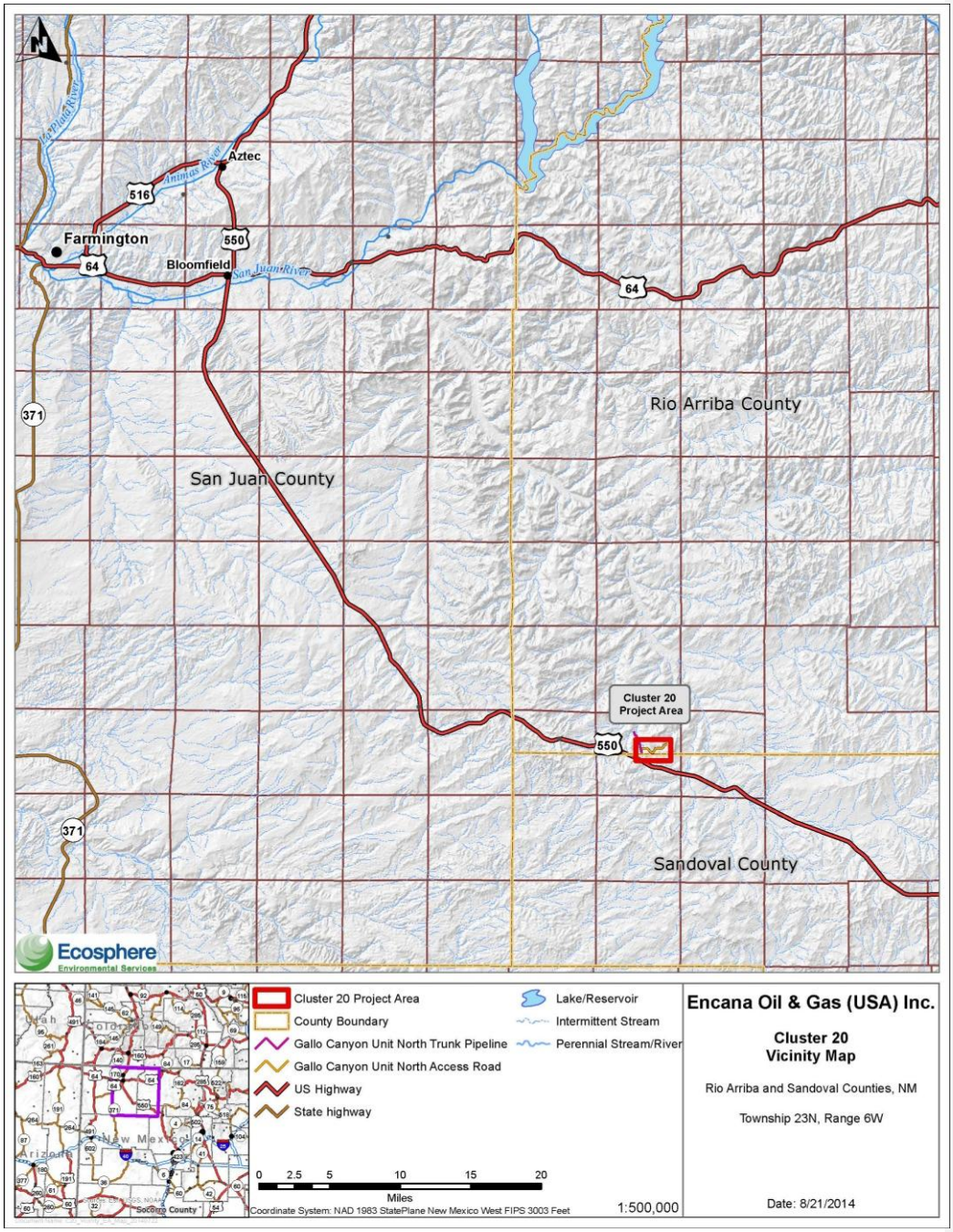


Figure 1. Proposed Cluster 20 and vicinity

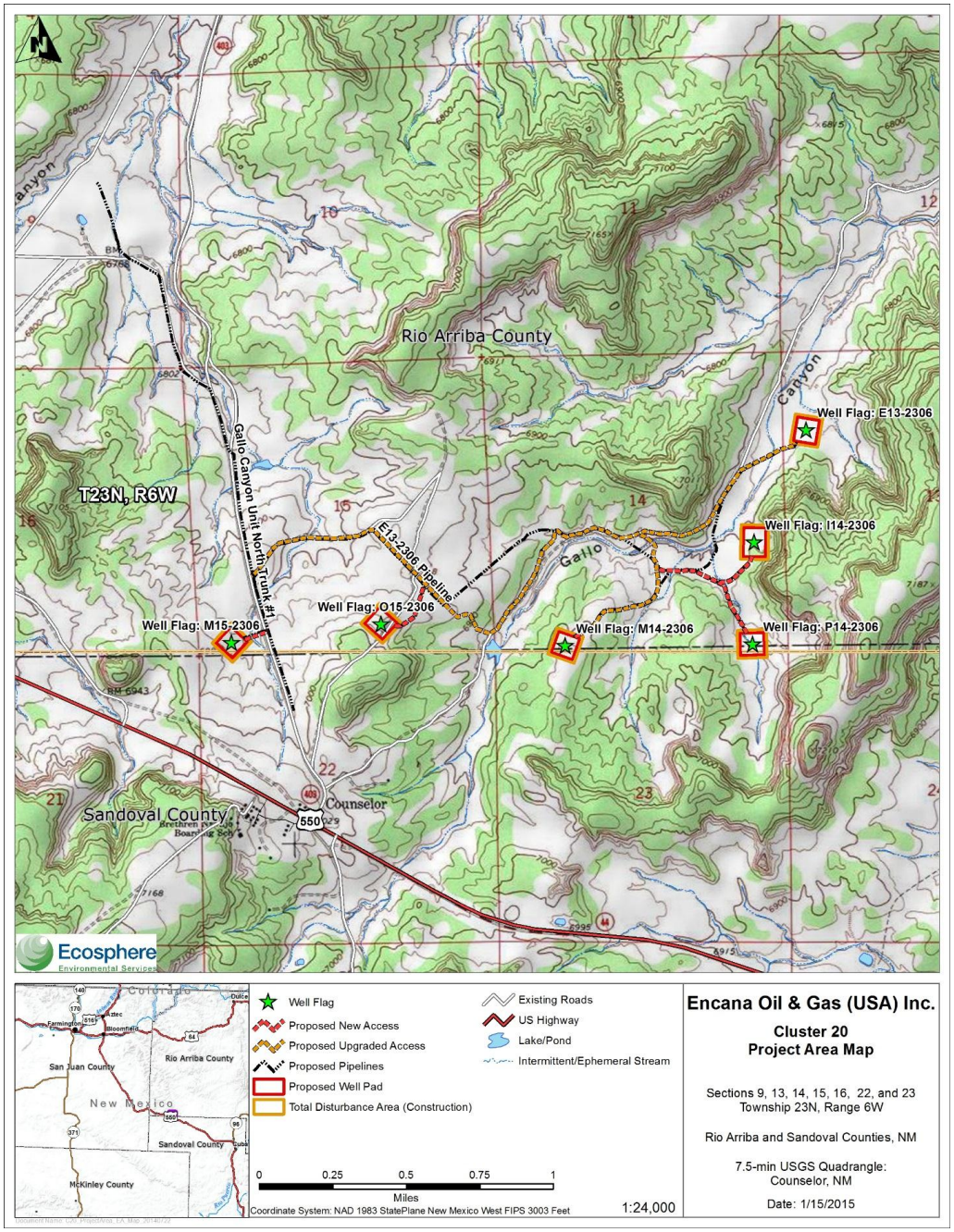


Figure 2. Proposed Cluster 20 Project Area

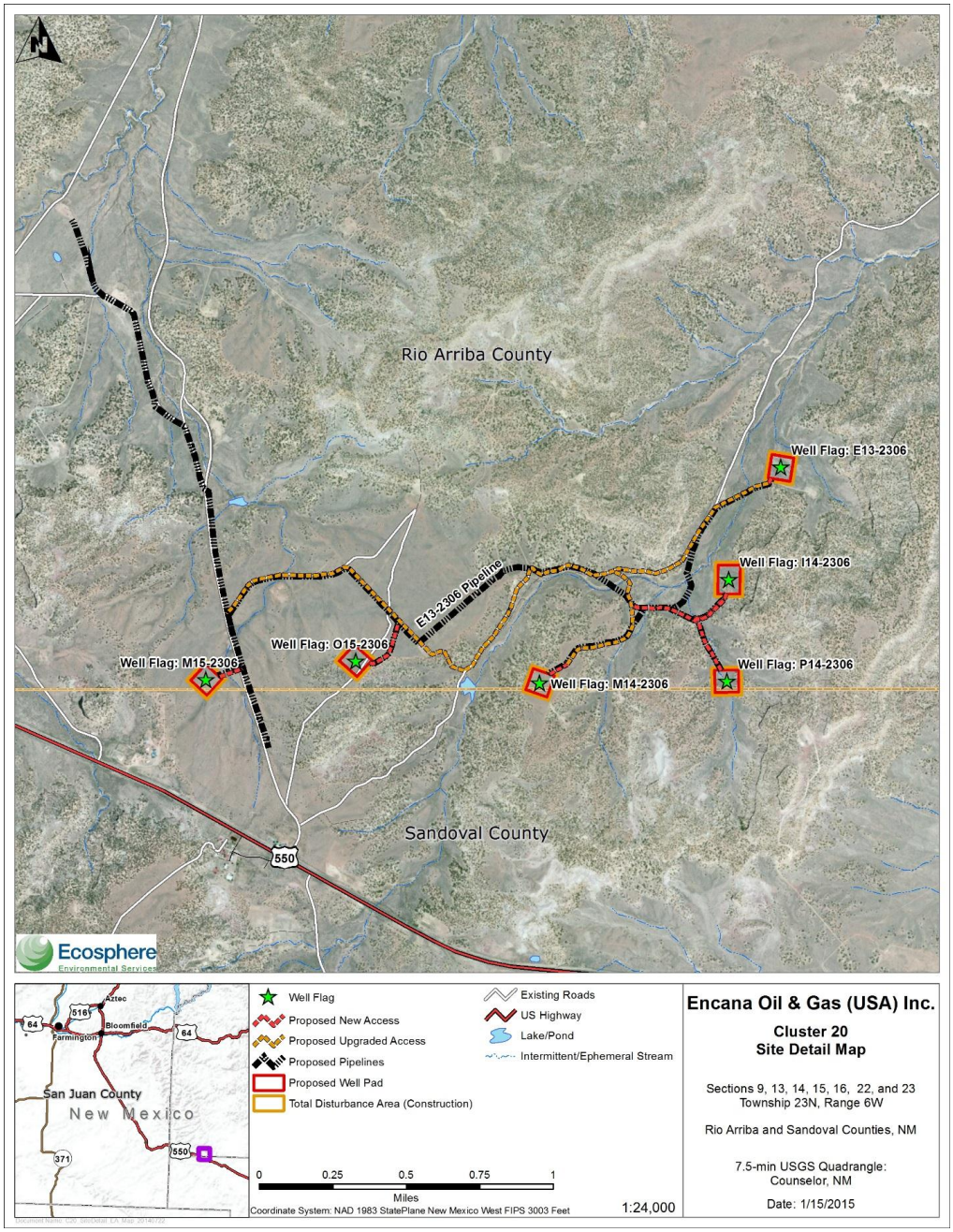
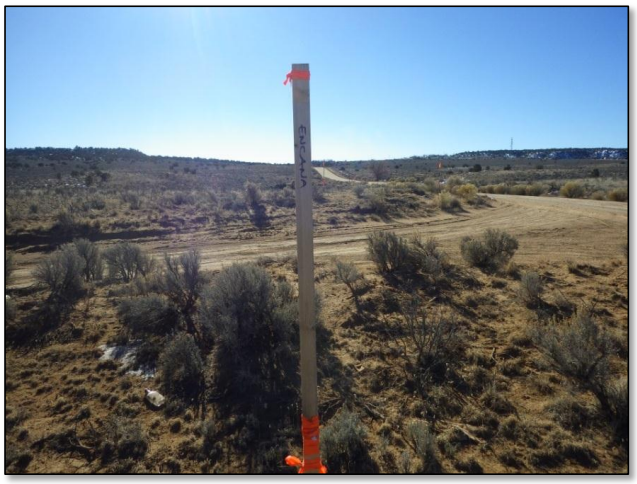


Figure 3. Proposed Cluster 20 Site Detail Map



Photograph 1. Gallo Canyon Unit North Trunk Pipeline looking south at Station 10+23

Photograph 2. Lybrook E13-2306 from the wellhead looking east

Photograph 3. Lybrook I14-2306 from corner 2 looking northwest

Photograph 4. Gallo Canyon Unit M14-2306 looking northeast

Photograph 5. Gallo Canyon Unit M15-2306 corner 3 looking east

Photograph 6. Gallo Canyon Unit O15-2306 from the beginning of the access road/pipeline right-of-way

Photograph 7. Gallo Canyon Unit P14-2306 corner 5 looking southwest

Appendix B – Applications for Permit to Drill and Right-of-Way Grants

Appendix C – Conditions of Approval and Pipeline Stipulations

Appendix D – Biological Survey Reports