Environmental Assessment
for
EOG Resources, Inc.

Crossbow 2016 Interim
Oil and Gas Exploration Project

WY-070- EA15-300

U.S. Department of the Interior
Bureau of Land Management
Buffalo Field Office
Buffalo, Wyoming

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BLM
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ABBREVIATIONS AND ACRONYMS

ACEPM	Applicant-Committed Environmental Protection Measures
AHPA	Archaeological and Historic Preservation Act
amsl	Above mean sea level
ANC	Acid Neutralizing Capacity
AO	Authorized Officer
APD	Application for Permit to Drill
AQD	Air Quality Division
AQRV	Air Quality Related Values
ARPA	Archaeological Resource Protection Action
AUM	Animal Unit Month
bbl	Barrel
BCC	Birds of Conservation Concern
BFO	Buffalo Field Office
BGEPA	Bald and Golden Eagle Protection Act of 1940
BLC	Board of Land Commissioners
BLM	Bureau of Land Management
BMP	Best Management Practice
BTEX	benzene, toluene, ethylbenzene, and xylene
CAA	Clean Air Act
CASTNET	Clean Air Status and Trends Network
CBNG	Coal bed natural gas
CEQ	Council on Environmental Quality
CFO	Casper Field Office
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CH_4	Methane
CIAA	Cumulative Impacts Assessment Area
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalents
COA	Condition of Approval
Core Areas	Sage-grouse Core Population Areas
CWA	Clean Water Act of 1972
dB	Decibel
DOI	Department of the Interior
DR	Decision Record
EA	Environmental Assessment
EHS	Extremely Hazardous Substances
EIS	Environmental Impact Statement
EO	Executive Order
EOG	EOG Resources, Inc.
ESA	Endangered Species Act of 1973

ESD	Ecological Site Description
ºF	Degrees Fahrenheit
FEIS	Final Environmental Impact Statement
FEM	Federal Equivalent Method
FEMA	Federal Emergency Management Agency
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
FOOGLRA	Federal Onshore Oil and Gas Leasing Reform Act of 1987
FR	Federal Register
FRM	Federal Reference Method
FSM	Forest Service Manual
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
GWP	Global Warming Potential
H_2S	Hydrogen Sulfide
HAPs	Hazardous Air Pollutants
HUC	Hydrologic Unit Code
HWA	Hayden-Wing Associates, LLC.
IM	Instruction Memorandum
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPCC	Intergovernmental Panel on Climate Change
JCR	Job Completion Reports
Kleinfelder	Kleinfelder, Inc.
K_w	Water Erosion Potential or Whole Soil Erosion Potential
lbs	Pounds
LRMP	Land and Resource Management Plan
LUP	Land Use Plan
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act of 1918
µeq/L	Microequivelents per Liter
µg/L	Micrograms per Liter
$\mu g/m^3$	Micrograms Per Cubic Meter
mg/L	Milligrams per Liter
MIS	Management Indicator Species
MLA	Mineral Leasing Act of 1920
MSUP	Master Surface Use Plan
N	North
N-hexane	Normal Hexane
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act of 1969

NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_4^-	Ammonium Ion
NHPA	National Historic Preservation Act of 1966
NO_2	Nitrogen Dioxide
NO_3-	Nitrate Ion
NO_X	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSS	Native Species Status
NSSU	Native Species Status Unknown
NTN	National Trends Network
NWI	National Wetlands Inventory
O_3	Ozone
OSLI	Office of State Lands and Investments
PM	Particulate Matter
PM_{10}	Particulate Matter less than 10 microns in diameter
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter
ppb	Parts Per Billion
ppm	Parts Per Million
PRB	Powder River Basin
Project	Crossbow 2016 Interim Oil and Gas Exploration Project
PSD	Prevention of Significant Deterioration
R	Range
RCRA	Resource Conservation Recovery Act
REL	Reference Exposure Levels
RfC	Reference Concentrations
RFD	Reasonably Foreseeable Development
RICE	Reciprocating Internal Combustion Engine
RMP	Resource Management Plan
RMRS	Rocky Mountain Research Station
ROD	Record of Decision
ROW	Right-of-Way
S	South
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheets
SGCN	Species of Greatest Conservation Need
SGEO	Sage-grouse Executive Order
SHP	Strategic Habitat Plan
SHPO	State Historic Preservation Officer
SLAMS	State and Local Monitoring Site
SMA	Surface Management Agency
SO_2	Sulfur Dioxide

SO_4^{2-}	Sulfate Ion
SPCC	Spill Prevention, Control, and Countermeasures
SPM	Special Purpose Monitoring
SUA	Surface Use Agreement
SWAP	State Wildlife Action Plan
T	Township
TBD	To Be Decided
TBNG	Thunder Basin National Grassland
TCP	Traditional Cultural Properties
US	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds
W	West
WAAQS	Wyoming Ambient Air Quality Standards
WAQSR	Wyoming Air Quality Standards and Regulations
WBCP	Wyoming Bird Conservation Plan
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WNv	West Nile Virus
WOGCC	Wyoming Oil and Gas Commission
WOS	Wildlife Observation System
WS	Wyoming Statute
WSGS	Wyoming State Geological Survey
WY	Wyoming
WYNDD	Wyoming Natural Diversity Database

1.0 PURPOSE AND NEED

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared to analyze and disclose the environmental effects that may result from implementing a proposal from EOG Resources, Inc. (EOG) for the Crossbow 2016 Interim Oil and Gas Exploration Project (Project). The Project is located within a 24,285-acre area (Project Area) in Converse County, Wyoming (WY) (**Figure 1.1-1**). The Project includes the proposed construction, drilling, completion, production, and reclamation of up to 47 horizontal oil and natural gas wells from up to six new and 10 existing well pads located on privately owned (fee) surface and lands owned by the State of Wyoming. Subsurface mineral ownership for the proposed wells includes fee, State of Wyoming, and federally owned minerals. The federally owned minerals are managed by the United States (US) Bureau of Land Management (BLM), and are located within the BLM Casper Field Office (CFO) planning area. While the Project is located within the CFO planning area, the BLM Buffalo Field Office (BFO) is completing the EA on behalf of the BLM CFO. The EA is tiered to the Record of Decision (ROD) and December 2007 Approved Casper Resource Management Plan (RMP), including the supporting Proposed RMP/Final Environmental Impact Statement (EIS) and 2012 RMP amendments, pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21 (BLM 2007a and 2007b). This EA also incorporates the management guidance for the greater sage-grouse (*Centrocercus urophasianus*) recently adopted by the CFO in Wyoming BLM's Approved Resource Management Plan Amendment for Greater Sage-Grouse (BLM 2015).

The proposed Crossbow 2016 Interim Oil and Gas Exploration Project largely occurs within the Greater Crossbow Project Area, for which an EIS is being prepared for project area-wide, programmatic exploration and development. While these two projects are separate in their purpose and needs (see **Section 1.3** for Purpose and Need for the 2016 Interim Oil and Gas Exploration Project EA), the overlap of project areas would allow for target reservoir delineation and production data generated by the 47 wells proposed in this EA to be analyzed and considered by the BLM in the Greater Crossbow Project EIS.

The proposed Project constitutes an externally initiated proposal that is a federal action and is therefore subject to analysis under the National Environmental Policy Action of 1969 (NEPA), as amended. This EA is an assessment of potential direct, indirect, residual, and cumulative impacts that could result from implementation of the Project and alternatives. Based on the result of the analysis in the EA, the BFO will determine whether a statement of Finding of No Significant Impact (FONSI) will be prepared, or whether an EIS will be required. A FONSI is a document that briefly presents the reasons why implementation of the selected alternative, or combination of alternatives, would not result in significant adverse impacts to the natural or human environment, when considering the context and intensity of potential impacts. Following consideration of impact analysis and applied mitigation in the EA, the BFO would prepare and execute a Decision Record (DR) and FONSI, thus approving the selected alternative. If the selected alternative is identified as having potential significant impacts, an EIS may be required.

1.2 BACKGROUND

On February 17, 2015, EOG met with the BFO to discuss the potential to complete an EA that would analyze the development of oil and natural gas wells in an area that overlaps with EOG's Greater Crossbow Project, for which the BFO and CFO are jointly developing an EIS.

EOG proposes to construct, drill, complete, produce, and reclaim up to 47 oil and natural gas wells. The Project Area consists of 24,285 acres within Converse County, including portions of Section 18, 20, 21, 22, and 23 of Township (T) 40 North (N), Range (R) 72 West (W); and portions of Sections 8, 13, 14, 15, 16, 22, 23, and 24 of T40N, R71W. Surface ownership within the Project Area includes fee, State of Wyoming, and US Forest Service (USFS) lands. New surface disturbance is only proposed on fee lands. Development on State of Wyoming lands would not result in new surface disturbance. EOG submitted APDs for the 47 proposed well locations on April 22, 2015.

Table 1.2-1. Project Area Land Status Summary

Surface Ownership	Acres	Percent of Project Area
Fee	20,996	86
State of Wyoming	1,848	8
USFS	1,441	6
Total	**24,285**	**100**

Source: BLM 2014a

It should be noted that surface ownership acreage does not necessarily correspond with subsurface mineral ownership acreage. Split-estate is separate ownership of the land surface and of the mineral estate associated with it. Under federal law, mineral owners have entry and development rights, provided surface owners are adequately compensated for the land use and disturbance. In cases where mineral and surface ownership are held in split-estate, mineral developers and the surface land owner typically enter into a surface access agreement (SAA). Agreements have been established for all well pads and access roads. All SAAs will be finalized before construction and development of the proposed facilities.

The mineral ownership within the Project Area includes fee, State of Wyoming, and federal, and it is anticipated that all three mineral estate ownership types would be accessed under the Project. While this EA analyzes the impacts associated with development of the entire 47 well proposal, the BLM would only be approving the production of federal minerals.

The Project Area contains a number of existing roads. These roads serve a variety of resource purposes including private ranch roads, county roads, and roads used for oil and gas exploration and development. A significant number of the existing roads are utilized for multiple purposes, such as access to both oil and gas development and private ranching operations. In addition, an existing system of state highways and county roads provide access to destinations within and through the Project Area. There are no interstate highways within the Project Area. Interstate Highway I-25 travels east to west, approximately 40 miles to the south of the Project Area through the town of Douglas, WY. Interstate Highway I-90 travels east to

west, approximately 60 miles north of the Project Area through the City of Gillette, WY. The only state highway within the Project Area is Highway 59, which runs north to south through the approximate center of the Project Area. This is the main access route into and out of the Project Area. There are several county roads that branch off of Highway 59 that provide access into the Project Area. There are approximately 3.3 miles of county roads within the Project Area. According to the Converse County Land Use Plan (LUP), some of the county roads have not been built to any weight or safety standards (Converse County 2003). Combined, there are approximately 93.8 miles of light duty and two-track type roads within the Project Area. The remaining roads within the Project Area are short and/or dead end roads that lead to existing oil and gas well pads.

Table 1.2-2. Project Area Road Status Summary

Road Type	Mileage Within the Project Area[1]
Interstate Highway	0
State Highway	4.7
County Road	3.3
Light Duty Road	9.6
Two-track Road	84.2

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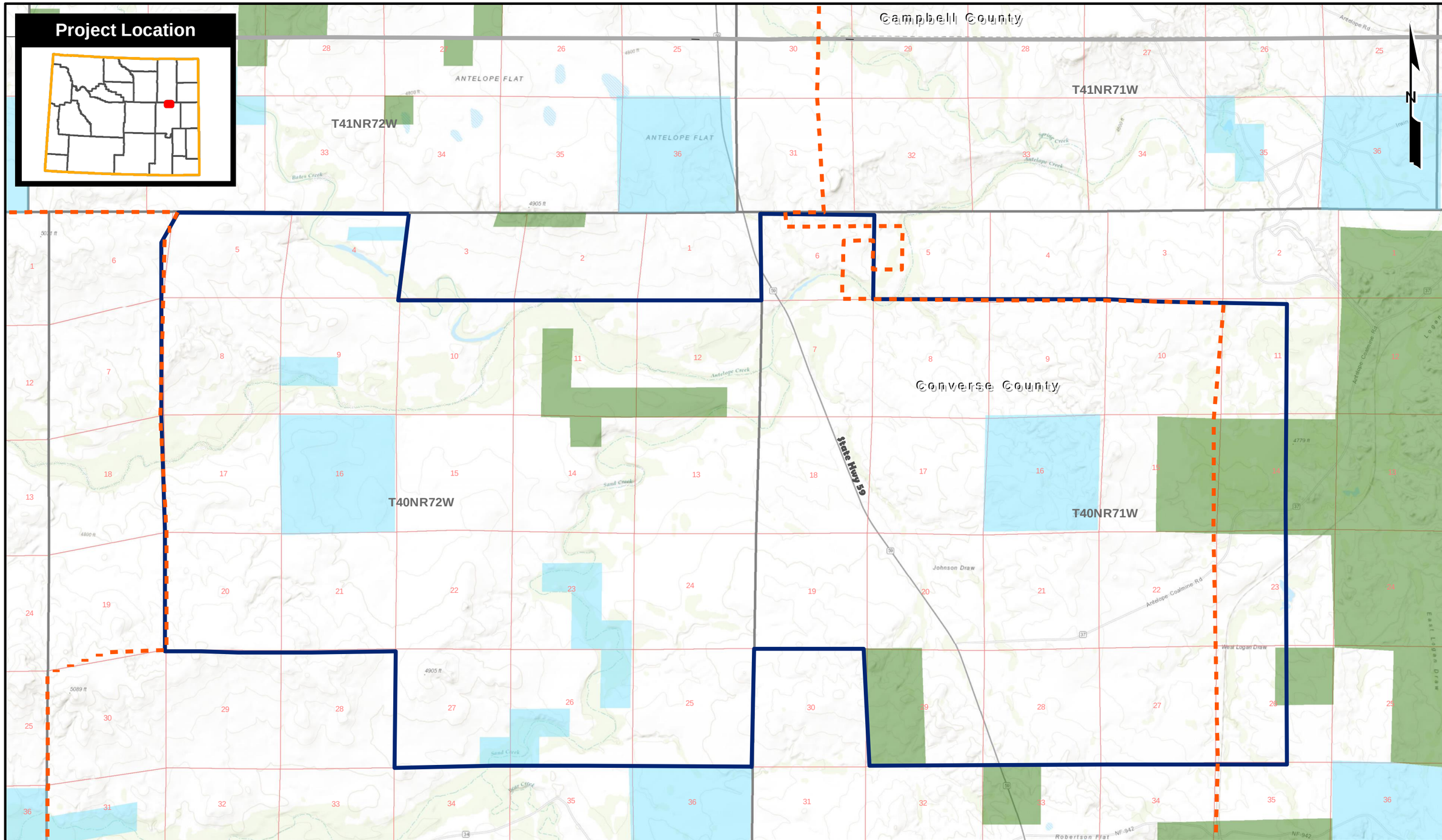

0 0.25 0.5 1 Miles

Legend

- Greater Crossbow EIS Project Area
- 2015 Interim EA Project Area
- County Boundary
- Township/Range Boundary
- Section Boundary

Surface Ownership

- Forest Service
- Private
- State

Project Area Boundary: EOG (2015)

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PROJECT NO.	20154640.001A
DRAWN:	12/30/2015
DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	1.1-1_ProjectArea.mxd

Crossbow 2016 Interim Drilling EA Project Area

EOG Resources, Inc.
Converse County, Wyoming

FIGURE

1.1-1

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1.3 PURPOSE AND NEED

The BLM's overall purpose of the action is to respond to EOG's proposal for the exploration of oil and natural gas resources on federally managed mineral leases consistent with lease rights, where valid and existing rights occur. The development of oil and gas resources is consistent with the mission of the BLM. The Federal Land Policy and Management Act of 1976 (FLPMA) mandates that the BLM manage public lands on the basis of multiple use (43 United States Code [USC] 1701(a)(7)). Under Section 103 of FLPMA, multiple use is defined as "a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific and historic values." Minerals are identified as one of the principal uses of public lands (43 USC 1702(c)). The BLM is responsible for administering activities consistent with rights associated with valid and existing leases. The Casper RMP specifically identified the BLM-managed mineral estate in the Project Area as available for the leasing of oil and natural gas (BLM 2007a).

EOG's purpose for the Project is to help define the target oil and gas reservoirs within the Project Area, thereby providing EOG better predictability for future exploration and development. Enhanced understanding of the reservoir geology will enable EOG to make more informed decisions on surface locations for future wells, and allow them to reduce surface disturbance related impacts. EOG's primary need is to help define the target and non-target oil and gas reservoirs for more efficient future development within the Greater Crossbow Area being analyzed in the Greater Crossbow EIS.

The BLM's need for exploration for oil and natural gas resources in the Project Area is established by the BLM's responsibility under the Mineral Leasing Action of 1920 (MLA), as amended, which provides that exploration and development of domestic oil and gas is in the best interest of the US. Private production from federal oil and gas leases is an integral component of the BLM's oil and gas leasing program under the authority of the MLA, as amended by FLPMA, and the Federal Onshore Oil and Gas Leasing Reform Action of 1987 (FOOGLRA).

1.4 DECISION TO BE MADE

The BLM will decide whether or not to approve the proposed Crossbow 2016 Interim Oil and Gas Exploration Project on federal mineral leases. If approved, the BLM will determine the terms and conditions for the Project, amenable to the BLM's multiple use mandate and the Casper RMP's environmental protection goals, objectives, and decisions/management actions.

1.5 RELATIONSHIP TO STATUTES, REGULATIONS, PLANS, OR OTHER ENVIRONMENTAL ANALYSES

In addition to those statutes, regulations, and plans previously presented, the Project would conform to those laws identified in **Table 1.5-1**. EOG would obtain any required permits or easements prior to the commencement of drilling operations.

Table 1.5-1. Federal, State, and Local Permits, Approvals, and Authorizing Actions Necessary for the Proposed Action

Issuing Agency	Nature of Permit/Approval	Authority
US Department of the Interior (DOI) BLM	Right-of-way (ROW) grants and temporary use clearances on federal lands	MLA, as amended (30 USC 185); FLPMA (43 USC 1761–1771); Title 43 CFR) 2800
	Application for Permit to Drill (APD) approvals on federal mineral leases	FOOGLRA, Energy Policy Act of 2005, MLA (30 USC 188 et seq.), as amended
	Antiquities and cultural resource assessments for federal undertakings	Antiquities Act of 1906 (16 USC 431433); Archaeological Resources Public Protection Act of 1979 (16 USC 470aa–470ll); 43 CFR 3; National Historic Preservation Act of 1966 (NHPA) and Advisory Council Regulations (36 CFR 800)
	Approval to dispose of produced water from BLM-managed land	MLA (30 USC 181 et seq.); Onshore Oil and Gas Order No. 7
	Management of noxious weed species on federal lands	Federal Noxious Weed Act of 1974 (7 USC 2801–2814, January 3, 1975, as amended 1988 and 1994)
US Army Corps of Engineers (USACE)	Section 404 permits regarding placement of dredged or fill materials in waters and adjacent wetlands	Section 404 of the Clean Water Act of 1972 (CWA) (40 CFR 122–123, 230)
US Fish and Wildlife Service (USFWS)	Coordination, consultation, and impact review for federally listed threatened and endangered species and other federally protected species	Fish and Wildlife Coordination Act (16 USC 661 et seq.); Section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 USC et seq.); Bald and Golden Eagle Protection Act (BGEPA), as amended (16 USC 668–668dd); Migratory Bird Treaty Act of 1918 (MBTA) (16 USC 704)
US Environmental Protection Agency (USEPA)	Spill Prevention, Control, and Countermeasure (SPCC) plans	40 CFR 112
	Regulation of hazardous waste treatment, storage, and/or disposal	Resource Conservation and Recovery Act (RCRA) (42 USC 6901)
Wyoming Department of Environmental Quality (WDEQ) - Water Quality Division	National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water and storm water runoff	Wyoming Environmental Quality Act (Wyoming Statutes [WS] 35-11-301 through 35-11-311); WDEQ Rules and Regulations, Chapter 18; Wyoming Environmental Quality Act (WS 35-11-301 through 35-11-311); Section 405 of the CWA (40 CFR 122124)
	Administrative approval for discharge of hydrostatic test water	Wyoming Environmental Quality Act (WS 35-11-301 through 35-11-311)

Issuing Agency	Nature of Permit/Approval	Authority
Wyoming Department of Transportation	Permits for oversize, overlength, and overweight loads	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations
	Utility and access permits for highway pipeline crossing and highway access construction	Title 12: Code of Civil Procedures; Chapter 26: Eminent Domain Rules and Regulations for Access Driveways as Approved by the Wyoming Highway Commission
Wyoming Oil and Gas Conservation Commission (WOGCC)	APD approvals statewide, to ensure industry compliance with statewide oil and gas laws and regulations	Title 30: Mines and Minerals; Chapter 5 Oil and Gas
	Authorization for flaring or venting of gas	WOGCC Regulations (Section III; Rule 326)
	Minimum safety standards for oil and gas activities	WOGCC Regulations (Rules 320-A, 327, and 328)
Wyoming Office of State Lands and Investments (OSLI)	Responsible for managing state trust lands and minerals	Organic Act, Sec. 14; Act of Admission, Sec. 4 through 14; Wyoming Constitution Article 7, Sec. 2, Sec. 6 through 8, Sec. 18, 19 and 22; Wyoming Constitution Article 18, Sec. 1, 2, 3, 4, 5, 6; WS 7-16-202; WS 8-4-102; W.S. 9-2-2005 through 2006; WS 9-2-2012; WS 9-4-305, WS 9-4-307 through 311; WS 9-4-601 through 607; WS 9-4-701, 703, 704 and 708 through 713; WS 9-4-801 through 815; WS 9-4-1001 through 1003; WS 9-12-703; WS 9-16-101 through 103; WS 10-3-101; WS 10-3-601 through 602; WS 11-5-101 through 303; WS 11-31-131;WS 11-34-101 through 306; WS 16-1-109 and 110; WS 16-1-201 through 207; WS 16-1-301 through 308; WS 21-15-106 and 111; WS 27-14- 701 through 704; WS 30-5-301 through 305; WS 35-11-528 through 532; WS 35-11-1201 through 1203; WS 36-1-101 through 36-3-111; WS 36-5-101 through 36-7-510; WS 36-9-101 through 120; WS 36-12-102, 106 and 107; WS 41-6-203 through 209.
Wyoming State Engineer's Office - Water Quality Division	Permits to appropriate groundwater (use, storage, wells, dewatering)	WS 41-121 through 41-147 (Form U.W.5)
Wyoming State Engineer's Office - Air Quality Division	Notification of potential emissions from production equipment	Wyoming Air Quality Standards and Regulations WDEQ Rules and Regulations
Wyoming State Historic Preservation Office	Cultural resource protection, programmatic agreements, consultation	Section 106 of the NHPA and Advisory Council Regulations (36 CFR 800)

1.6 SCOPING, PUBLIC INVOLVEMENT, AND ISSUES

The BFO posted the 47 proposed APDs for 30 days and will timely publish the EA, any finding, and decision on the BFO website; no comments were received. BLM hosted public scoping meetings for the Greater Crossbow EIS in Douglas and Gillette on December 9 and 10, 2015 respectively. Issues identified at the public meetings included split estate management (private surface access), compatibility with potential coal development, and raptor conservation. Written comments are still being collected; to date, the written comments are consistent with what was identified at the public meetings and through internal scoping.

Onsites were conducted for the Project on March 18 and 19, 2015. Internal scoping was performed with an interdisciplinary team of specialists from the BFO, EOG, and representatives from Kleinfelder, Inc. (Kleinfelder), the third-party contractor preparing the EA. Resources identified during the internal scoping process are discussed in **Chapter 3**, *Affected Environment*, and impacts to those resources are disclosed in **Chapter 4,** *Environmental Effects*, and **Chapter 5**, *Cumulative Effects*. Those resources not carried forward for analysis and the rationale for dismissal are documented in the *Affected Resources Checklist* included in **Appendix A**. Site-specific onsite comments are provided in **Appendix B**.

1.7 ALTERNATIVES CONSIDERED BUT DISMISSED

1.7.1 Maximum Drilling Alternative (Up to 22 Wells per Pad)

The BFO considered an alternative where the number of new wells would increase from 47 wells to 307 wells. Under this alternative considered, each new well pad would be constructed to a size that accommodates up to 22 wells, which is up to 19 more wells per pad than the Proposed Action Alternative (see **Section 2.2**, *Proposed Action Alternative*). In addition, existing pads for which new Project wells would be collocated would be expanded to accommodate a total of up to 22 wells, including the existing wells on the pad. These optimized well pads would require up to approximately 39 acres of initial surface disturbance. Based upon the drilling of 127 wells from six new pads and 180 wells from 10 existing pads, a total of 567.6 acres of new initial surface disturbance would be anticipated under this alternative. The anticipated surface disturbance for the maximum drilling alternative is presented in **Table 1.7-1**.

Table 1.7-1. Dismissed Maximum Drilling Alternative – Anticipated Surface Disturbance

Well Pad	Quantity	Total Initial Surface Disturbance (Acres)
New Optimized Well Pad[1]	6 Pads	234
Optimized Existing Well Pad[2]	10 Pads	323
New and Upgraded Access Roads	9,325 Feet	10.6
Total	**--**	**567.6**

[1] Assumes each new optimized pad would be constructed with an initial surface disturbance of approximately 39 acres.

[2] Assumes each optimized existing pad would be expanded from its current size to approximately 39 acres.

This maximum drilling alternative does not meet the Project's purpose as these 307 wells greatly exceed the number of wells needed to define and collect production data on the target and non-target oil and gas reservoirs within the Project Area in 2016. The Project, as proposed, will provide predictability and understanding of the target oil and gas reservoirs for further exploration and eventual development, while minimizing environmental impacts (**Section 1.3**, *Purpose and Need*). Conversely, this alternative would result in approximately 457.4 more acres of surface disturbance than the Proposed Action, which would also increase the amount of surface disturbance when compared with the Proposed Action. Dismissal of this alternative does not preclude future needs for additional exploration or development of reservoir resources within the Project Area, and such proposals would be analyzed in separate NEPA analyses.

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2.0 DESCRIPTION OF ALTERNATIVES

This EA analyzes two alternatives: the No Action Alternative and Proposed Action Alternative.

2.1 NO ACTION ALTERNATIVE

The Council on Environmental Quality (CEQ) regulations implementing NEPA require the consideration of the alternative of No Action (40 CFR 1502.14). Under the No Action Alternative, the APDs for 47 wells with federal mineral estate would not be approved and the associated well pads and access road ROWs would not be authorized. Selection of the No Action Alternative would effectively be a denial of the operator's proposal, and would preclude EOG access to its valid and existing federal mineral rights. As such, implementation of the No Action Alternative would provide EOG and the BLM with less understanding of the underlying geology, which would be less informative to future development. While access to federal mineral estate would be denied under the No Action Alternative, proposed oil and natural gas development would likely continue within the Project Area on surface estate with state or fee mineral estate, subject to the approval of the WOGCC.

Under the No Action Alternative, up to eight horizontal oil and natural gas wells would be developed in the Project Area from two proposed and two existing well pads located on fee and state surface estate. These wells, as proposed, would target the Turner and Parkman formations, but would also help to obtain geologic data on the Mowry, Niobrara, Shannon, Sussex, and potentially other formations within fee and state mineral estate. A summary of the proposed wells, associated well pads, and associated surface and mineral ownership is provided in **Table 2.1-1**. The eight wells in **Table 2.1-1** do not require BLM review and approval, and would therefore be developed pending approval by the Wyoming Oil and Gas Conservation Commission. The proposed development for the No Action Alternative and existing infrastructure related to this alternative is depicted on **Figure 2.1-1**.

Table 2.1-1. Well Name, Location, and Surface/Mineral Ownership under the No Action Alternative

Well Pad Name	Surface Location	Well Name	Surface Hole Lease	Bottom Hole Lease
Blade 21 SENE (Proposed)	SENW S21 T40N R71W	Blade 2-2116H	Fee	Fed
		Blade 427-2116H		
		Blade 428-2116H		
Blade 21 SENW (Existing)	SENE S21 T40N R71W	Blade 431-2116H	Fee	Fed
		Blade 432-2116H		
Blade 22 NWNW (Proposed)	NWNW S22 T40N R71W	Blade 29-22H	Fee	Fed
		Blade 425-22H		
Mary's Draw 16 NWNE (Existing)	NWNE S16 T40N R72W	Mary's Draw 3-16H	State of Wyoming	Fee

Source: Uintah Engineering 2015a-e

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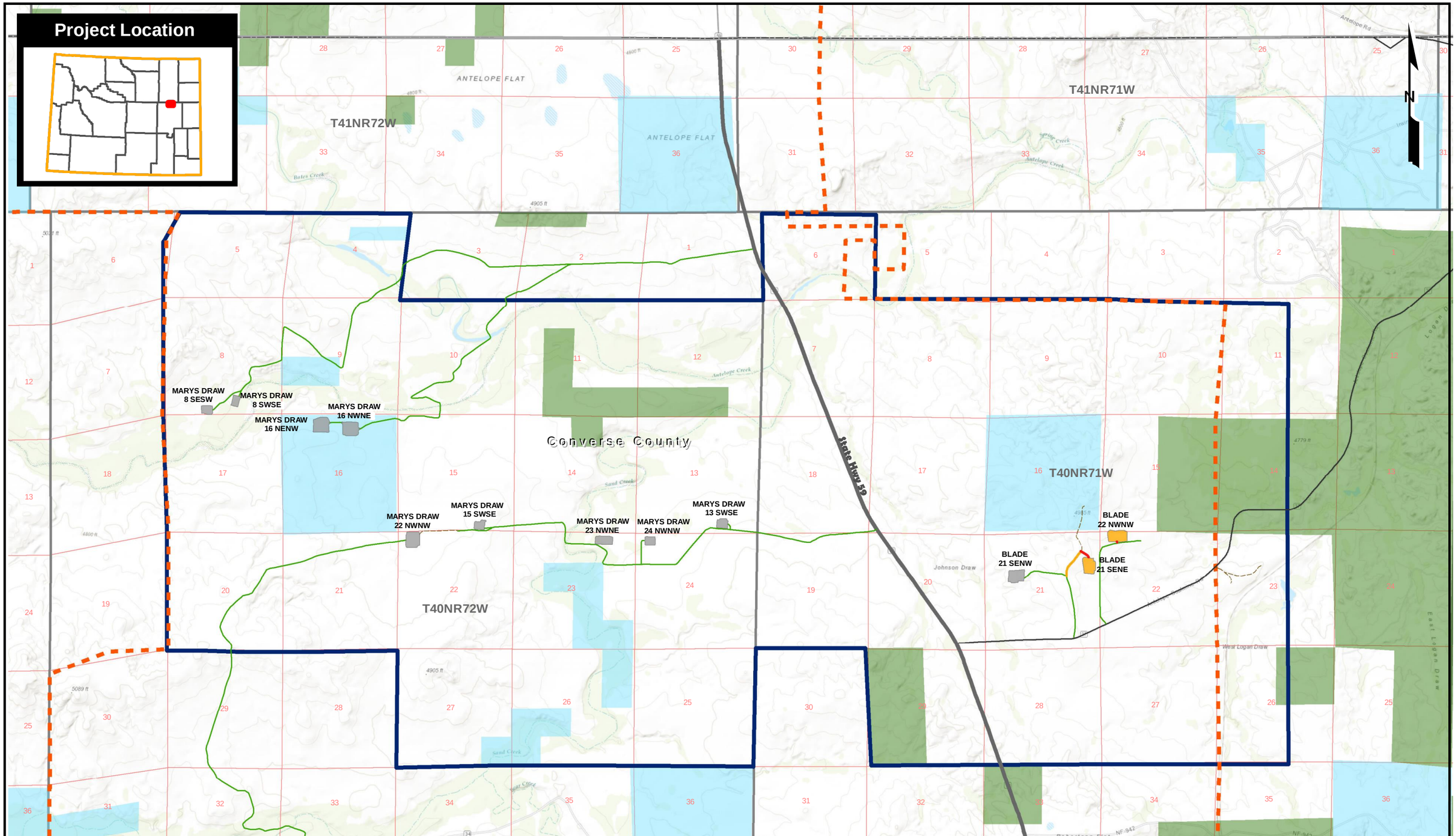

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Legend

- Proposed Well Pad
- Existing Well Pad
- Proposed Access Road
- Proposed Road Upgrade
- Highway
- County Road
- Existing Access Road
- Existing Two-track
- Greater Crossbow EIS Project Area
- County Boundary
- Township/Range Boundary
- Section Boundary

Project Area Boundary: EOG (2015)

- 2015 Interim EA Project Area

Surface Ownership

- Forest Service
- Private
- State

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Crossbow 2016 Interim Drilling EA
No Action Alternative

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
2.1-1

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Surface disturbance by well pad and activity is provided below in **Table 2.1-2**. The development of utility lines and production pipelines for these wells is not included at this time. As such, all oil and produced water would be stored onsite in tanks, and all onsite power would be provided by generators fueled using natural gas produced from the wellhead. Construction associated with the No Action Alternative would result in approximately 21.486 acres of initial surface disturbance. Areas with exposed soils would be stabilized within 30 days of completion of site construction. Interim site reclamation would be completed for portions of the well pad not required for production activities within six months of well completion, weather permitting.

Table 2.1-2. Estimated Total Surface Disturbance by Well Pad and Project Feature under the No Action Alternative

Well Pad Name	Pad Activity	Length (Feet)[1]	Existing Surface Disturbance (Acres)	Proposed Surface Disturbance (Acres)[1]
Blade 21 SENE (Proposed Location)	Proposed Well Pad		-	8.622
	Proposed Access Road	1,887	-	0.727
	Proposed Road Upgrade		-	1.872
	Subtotal Proposed Disturbance		**-**	**11.221**
Blade 21 SENW* (Existing Location)	Existing Well Pad		8.894	-
	Existing Access Road		4.556	-
	Subtotal Existing Disturbance		**13.450**	**-**
Blade 22 NWNW (Proposed Location)	Proposed Well Pad		-	10.184
	Proposed Access Road	69	-	0.081
	Subtotal Proposed Disturbance		**-**	**10.265**
Mary's Draw 16 NWNE (Existing Location)*	Existing Well Pad		10.021	-
	Existing Access Road		22.094	-
	Subtotal Existing Disturbance		**32.115**	**-**
Total Surface Disturbance[2]		**1,956**	**45.565**	**21.486**

[1] Proposed road construction is based on a 60-foot-wide short-term disturbance width.
[2] Total acreage estimates are based on Geographic Information System (GIS) software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development and minute boundary discrepancies. GIS-based calculations are considered more accurate than estimates calculated using simple addition and therefore will be utilized throughout this document, wherever possible.
*Expansion of the existing well pad or changes to the existing road system would not be required.
Source: Uintah Engineering 2015a-e

Selection of the No Action Alternative would not void prior approvals of EOG federal projects. Specifically, EOG has received approvals or is waiting on approvals to drill 60 wells within the Project Area. In addition, two wells have been approved by the BLM and State of Wyoming for operators other than EOG. Finally, 37 producing/active wells are present within the Project Area and would continue to produce regardless of the BLM's selection of the No Action Alternative. Existing and approved wells are presented by well status in **Table 2.1-3**. These wells are discussed in further detail in **Section 3.5.2**, *Leasable Minerals*, and depicted in **Figure 3.5.2-1**.

Table 2.1-3. Status of Existing and Approved Oil and Gas Wells within the Project Area

Operator	Existing Wells		Approved/ Applications Pending	Unknown Status/Other	Total
	Producing/Active	Not Producing/Inactive			
EOG	27	3	60	1	91
Other Operators	10	1	2	0	13
Total	**37**	**4**	**62**	**1**	**104**

Source: WOGCC 2015a

Under the No Action Alternative, the proposed oil and natural gas development described in the Proposed Action Alternative would not be implemented; however, as discussed above, oil and natural gas development would continue to occur for non-federal surface and mineral estate, and for federal surface and mineral estate under the authority of prior approvals.

2.2 PROPOSED ACTION ALTERNATIVE

EOG proposes to drill up to 47 horizontal oil and natural gas wells in the Project Area from six new and 10 existing well pads located on fee and state surface estate. These wells would target the Turner and Parkman formations within federal mineral estate. The proposed wellbores would also collect geologic data on the Mowry, Niobrara, Shannon, Sussex, and/or other formations within federal mineral estate. Should EOG determine during exploration that these additional formations would be productive at economic levels, EOG may submit a Sundry to the BLM to modify an APD to include the new target formation(s). A summary of the proposed wells, associated well pad, and associated surface and mineral ownership is provided in **Table 2.2-1**. The proposed development is depicted on **Figure 2.2-1**. Because the referenced wells are exploratory, the sales point would be determined after production is established.

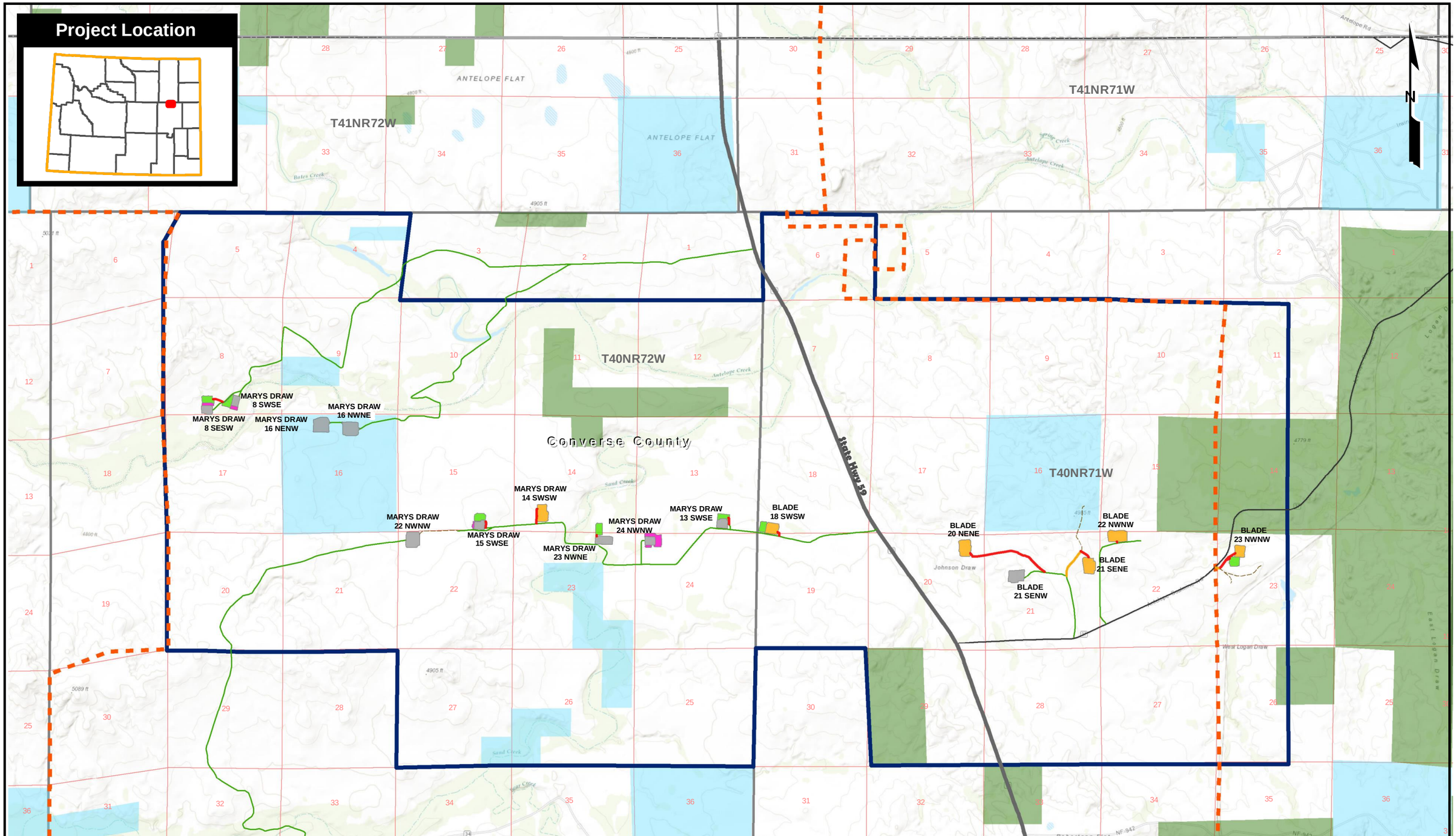
Table 2.2-1. Well Name, Location, and Surface/Mineral Ownership under the Proposed Action Alternative

Well Pad Name	Pad Status	Well Name	Surface Hole Lease	Bottom Hole Lease
Blade 18 SWSW (Proposed)	SWSW S18 T40N R71W	Blade 41-18H	Fed	Fed
		Blade 450-18H		
		Blade 43-18H		Fed
		Blade 42-18H		
		Blade 451-18H		
		Blade 452-18H		
Blade 20 NENE (Proposed)	NENE S20 T40N R71W	Blade 34-2029H	Fed	Fed
		Blade 437-2029H		
		Blade 438-2029H		

Well Pad Name	Pad Status	Well Name	Surface Hole Location Lease	Bottom Hole Location Lease
Blade 21 SENE (Proposed)	SENW S21 T40N R71W	Blade 4-2128H	Fee	Fed
		Blade 429-2128H		
		Blade 430-2128H		
Blade 21 SENW (Existing)	SENE S21 T40N R71W	Blade 32-2128H	Fee	Fed
		Blade 433-2128H		
		Blade 434-2128H		
Blade 22 NWNW (Proposed)	NWNW S22 T40N R71W	Blade 39-2210H	Fee	Fed
		Blade 426-2210H		
		Blade 447-2210H		
Blade 23 NWNW (Proposed)	NWNW S23 T40N R71W	Blade 25-23H	Fed	Fed
		Blade 419-23H		
		Blade 420-23H		
Mary's Draw 8 SESW (Existing)	SESW S8 T40N R72W	Mary's Draw 46-0805H	Fee	Fee
		Mary's Draw 55-08H		Fed
Mary's Draw 8 SWSE (Existing)	SWSE S8 T40N R72W	Mary's Draw 51-08H	Fee	Fed
		Mary's Draw 495-08H		
		Mary's Draw 52-0805H		Fee
Mary's Draw 13 SWSE (Existing)	SWSE S13 T40N R72W	Mary's Draw 491-13H	Fee	Fed
		Mary's Draw 492-13H		Fed
Mary's Draw 14 SWSW (Proposed)	SWSW S14 T40N R72W	Mary's Draw 53-14H	Fed	Fed
		Mary's Draw 487-14H		
		Mary's Draw 488-14H		
		Mary's Draw 54-1426H		STWY 5-00520
		Mary's Draw 489-1426H		
		Mary's Draw 490-1426H		Fed
Mary's Draw 15 SWSE (Existing)	SWSE S15 T40N R72W	Mary's Draw 493-15H	Fed	Fed
		Mary's Draw 494-1527H		Fed
		Mary's Draw 27-16H	STWY10-00526	Fed

Well Pad Name	Pad Status	Well Name	Surface Hole Location Lease	Bottom Hole Location Lease
Mary's Draw 16 NENW (Existing)	NENW S16 T40N R72W	Mary's Draw 424-16H		
		Mary's Draw 432-16H		
Mary's Draw 16 NWNE (Existing)	NWNE S16 T40N R72W	Mary's Draw 433-16H	STWY10-00526	Fee
Mary's Draw 22 NWNW (Existing)	NWNW S22 40N R72W	Mary's Draw 267-2227H	Fee	Fed
		Mary's Draw 461-2227H		
		Mary's Draw 462-2227H		
Mary's Draw 23 NWNE (Existing)	NWNE S23 T40N R72W	Mary's Draw 49-23H	Fee	Fed
		Mary's Draw 50-2326H		Fed
Mary's Draw 24 NWNW (Existing)	NWNW S24 T40N R72W	Mary's Draw 483-24H	Fee	Fee
		Mary's Draw 484-24H		Fed
				Fed

Source: Uintah Engineering 2014 and Uintah Engineering 2015a-r



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Legend

- Proposed Well Pad
- Proposed Facilities Pad
- Proposed Pad Expansion
- Existing Well Pad
- Proposed Access Road
- Proposed Road Upgrade
- Highway
- County Road
- Existing Access Road
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- Private
- State

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Crossbow 2016 Interim Drilling EA
Proposed Action Alternative

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
2.2-1

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2.2.1 Construction Activities

The Proposed Action would utilize existing oil and gas infrastructure (e.g., access roads, well pads, etc.) where possible, but would also require the construction of new pads and access road locations. This existing infrastructure is depicted in **Figure 2.2-1** and identified in **Table 2.2.1.1-1**.

2.2.1.1 Well Pads

The proposed 47 wells would be located on six new well pads and 10 existing well pads that would require expansion. The well pads would be sized to accommodate the short- and long-term equipment required to safely drill and operate the wells. The size of the new well pads would be dependent on the number of wells drilled on the pad, and would range between 5.7 and 10.2 acres of initial surface disturbance per pad, including topsoil and subsoil stockpiles rock, cut/fill materials, ditches around the pad, etc. Anticipated well pad expansions would range between 0.5 and 7.2 acres, for a total initial surface disturbance for new and expanded well pads of approximately 59.1 acres. Estimated surface disturbance by well pad and activity is provided in **Table 2.2.1.1-1**. The development of utility lines and production pipelines for these wells is not included, as all oil and produced water would be stored onsite in tanks, and all onsite power would be provided by generators fueled using natural gas produced from the wellhead.

Table 2.2.1.1-1. Estimated Total Surface Disturbance by Well Pad and Project Feature under the Proposed Action Alternative

Well Pad Name	Pad Activity	Length (Feet)	Existing Surface Disturbance (Acres)	Proposed Surface Disturbance (Acres)[1]
Blade 18 SWSW (Proposed Location)	Proposed Well Pad		-	6.495
	Proposed Facilities Pad		-	3.080
	Proposed Access Road	247	-	0.340
	Subtotal Proposed Disturbance		-	**9.915**
Blade 20 NENE (Proposed Location)	Proposed Well Pad		-	8.933
	Proposed Access Road	3,884	-	5.350
	Subtotal Proposed Disturbance		-	**14.283**
Blade 21 SENE (Proposed Location)	Proposed Well Pad		-	8.622
	Proposed Access Road	1,887	-	0.727
	Proposed Road Upgrade		-	1.872
	Subtotal Proposed Disturbance		-	**11.221**
Blade 21 SENW* (Existing Location)	Existing Well Pad		8.894	-
	Existing Access Road		4.556	-
	Subtotal Existing Disturbance		**13.450**	-
Blade 22 NWNW (Proposed Location)	Proposed Well Pad		-	10.184
	Proposed Access Road	69	-	0.081
	Subtotal Proposed Disturbance		-	**10.265**

Well Pad Name	Pad Activity	Length (Feet)	Existing Surface Disturbance (Acres)	Proposed Surface Disturbance (Acres)[1]
Blade 23 NWNW (Proposed Location)	Proposed Well Pad		-	5.687
	Proposed Facilities Pad		-	4.300
	Proposed Access Road	1,385	-	1.908
	Subtotal Proposed Disturbance		-	**11.895**
Mary's Draw 8 SESW (Existing Location)	Existing Well Pad		4.139	-
	Proposed Pad Expansion		-	1.626
	Proposed Facilities Pad		-	3.740
	Proposed Access Road	523	-	0.720
	Existing Access Road		8.041	-
	Subtotal Existing Disturbance		**12.180**	**-**
	Subtotal Proposed Disturbance		**-**	**6.086**
Mary's Draw 8 SWSE (Existing Location)	Existing Well Pad		3.515	-
	Proposed Pad Expansion		-	1.319
	Proposed Facilities Pad		-	3.394
	Subtotal Existing Disturbance		**3.515**	**-**
	Subtotal Proposed Disturbance		**-**	**4.713**
Mary's Draw 13 SWSE (Existing Location)	Existing Well Pad		3.943	-
	Proposed Facilities Pad		-	3.740
	Proposed Access Road	367	-	0.505
	Existing Access Road		0.376	-
	Subtotal Existing Disturbance		**4.319**	**-**
	Subtotal Proposed Disturbance		**-**	**4.245**
Mary's Draw 14 SWSW (Proposed Location)	Proposed Well Pad		-	8.588
	Proposed Access Road	772	-	1.063
	Subtotal Proposed Disturbance		**-**	**9.651**
Mary's Draw 15 SWSE (Existing Location)	Existing Well Pad		3.958	
	Proposed Pad Expansion		-	0.467
	Proposed Facilities Pad		-	3.981
	Proposed Access Road	347	-	0.478
	Existing Access Road		0.153	-
	Subtotal Existing Disturbance		**4.111**	**-**
	Subtotal Proposed Disturbance		**-**	**4.926**
Mary's Draw 16 NENW (Existing Location)*	Existing Well Pad		11.830	-
	Existing Access Road		0.667	-
	Subtotal Existing Disturbance		**12.497**	**-**

Well Pad Name	Pad Activity	Length (Feet)	Existing Surface Disturbance (Acres)	Proposed Surface Disturbance (Acres)[1]
Mary's Draw 16 NWNE (Existing Location)	Existing Well Pad		10.021	-
	Existing Access Road		22.094	-
	Subtotal Existing Disturbance		**32.115**	**-**
Mary's Draw 22 NWNW (Existing Location)*	Existing Well Pad		9.464	-
	Existing Access Road		8.995	-
	Subtotal Existing Disturbance		**18.459**	**-**
Mary's Draw 23 NWNE (Existing Location)	Existing Well Pad		6.676	-
	Proposed Facilities Pad		-	3.664
	Proposed Access Road	93	-	0.128
	Existing Access Road		0.018	-
	Subtotal Existing Disturbance		**6.694**	**-**
	Subtotal Proposed Disturbance		**-**	**3.792**
Mary's Draw 24 NWNW (Existing Location)	Existing Well Pad		3.357	-
	Proposed Pad Expansion		-	7.165
	Existing Access Road		1.491	-
	Subtotal Existing Disturbance		**4.848**	**-**
	Subtotal Proposed Disturbance		**-**	**7.165**
Total Surface Disturbance[2]		**9,574**	**112.188**	**98.157**

[1] Proposed road construction is based on a 60-foot-wide short-term disturbance width.
[2] Total acreage estimates are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development and minute boundary discrepancies. GIS-based calculations are considered more accurate than estimates calculated using simple addition and therefore will be utilized throughout this document, wherever possible.
*Expansion of the existing well pad or changes to the existing road system would not be required.
Source: Uintah Engineering 2014 and Uintah Engineering 2015a-r

Use of erosion control measures may include grading to minimize slopes, diversion terraces, and ditches, mulching, terracing, riprap, fiber matting, temporary sediment traps and broad-based drainage dips or low water crossings would be applied to minimize surface erosion and surface run-off during well pad construction and operation. Cut and fill slopes would be constructed to maintain stability for the life of the Project. Topsoil would be stripped and stored separately from subsoil materials. Material to construct the pads would consist of native borrow and soil, but may require mineral materials such as rock, gravel, or sand to meet engineering standards. Authorized gravel sources for the Project are provided in **Table 2.2.1.1-2**.

Table 2.2.1.1-2. Authorized Gravel Sources for the Proposed Action Alternative

Source Name	Source Location	County
Stock Pit	SWNW & W1/2SW1/4, Sec 7, T33N, R72W	Converse County, WY
Collins Quarry	NENW, Sec 30, T30N, R68W	Platte County, WY
Western Sunset LLC State #1	NESW, Sec 36, T40N, R71W	Converse County, WY
Buffalo Ranch Pit	SWNW & NWSW, Sec 7, T44N, R71W	Campbell County, WY
Burgess Pit	SENE & NESE, Sec 16 T56N, R82W	Sheridan County, WY
DZ Pit	NESE & NWSE Sec 25 & 26, T52N, R66W	Crook County, WY
Fetterman Pit	SENW, Sec 7 T33N, R72W	Converse County, WY
Hadley Ranch Pit	N1/2N1/2 Sec 10, S1/2S1/2 Sec 3, T25N, R68W	Platte County, WY
McInerney Pit	SW 1/4 & NW ¼ Sec 3, T50N, R62W	Crook County, WY
Ohman Pit	N1/2NW1/4, Sec 7, T45N, R72W	Campbell County, WY
Savageton Pit	SW1/4, Sec 35, T46N, R74W	Campbell County, WY
East Thar Pit	NESE, Sec 1, T49N, R71W	Campbell County, WY
West Pit	SWSE & SESW, Sec 3, T54N, R67W	Crook County, WY

EOG would use closed-loop drilling methods, described in further detail in **Section 2.2.2.1**, *Well Drilling*. Closed-loop drilling would not require the construction of a reserve pit, and no reserve pits are proposed.

EOG would install and utilize remote wellhead telemetry at the well sites to monitor well and facility operational parameters. The use of telemetry would reduce vehicle traffic to the site and thus reduce traffic noise, dust generation, and the potential for vehicle incidents.

2.2.1.2 Facilities Pads

Seven facilities pads would be constructed adjacent to five existing well pads and two proposed well pad locations (**Figure 2.2-1**). Construction of the facilities pads would be similar to the construction of new well pads (refer to **Section 2.2.1.1**, *Well Pads*) and layout for each would be depicted in the APD packages. The size of the facilities pads would range between 3.1 to 4.3 acres of initial surface disturbance per pad, including topsoil and subsoil stockpiles, rock, cut/fill materials, ditches around the pad, etc. The pads would be sized to accommodate the short- and long-term equipment required to safely support operation of the wells.

2.2.1.3 Access Roads

A network of roads already exists within the Project Area, and existing roadways would be used wherever possible. The existing roads would be maintained in the same or better condition as existed prior to the commencement of construction and operations. Maintenance of the roads would continue until final abandonment and reclamation of the wells.

Approximately 9,574 feet (1.8 miles) of new or upgraded access road would be required to access the proposed oil and natural gas wells in the Project Area. The average initial disturbance width for new access

roads would be approximately 60 feet, for a total of 13.2 acres of initial surface disturbance. All surface-disturbing activities related to road construction would be confined to the authorized access road ROW area. The proposed access roads would be constructed to meet the standards of the anticipated traffic flow and all-weather requirements. Construction would include ditching, draining, graveling, and crowning of the roadbed in accordance EOG's Storm Water Management Plan. All surfaces not needed for the production phase would undergo interim reclamation, weather permitting (see **Section 2.2.5**, *Reclamation*).

The new access roads would be completed with a total running width of approximately 22 feet. Best Management Practices (BMPs) would be installed as needed and are depicted in the APD packages. Turnouts would be installed every 500 to 800 feet depending on visibility. Turnouts would be approximately 24 feet wide and 40 to 60 feet long within the 60-foot-wide ROW.

The maximum grade of the new access roads would be less than eight percent. There are no major cuts or fills, bridges, gates, or fences anticipated along the proposed access routes. Ditches constructed alongside access roads would be constructed with a four-to-one slope. Rip rap would be used along the slopes as needed for stabilization. A minimum of six inches of topsoil would be stripped from the proposed access road ROW prior to any further construction activity. Stripped topsoil would be stockpiled along the sides of the new access road for use during reclamation activities, and stabilized by seeding and/or matting as appropriate. Three-inch minus gravel would be used to construct the road.

The new access roads would be constructed and maintained as necessary to prevent soil erosion and accommodate all-weather traffic. The roads would be crowned and ditched with water turnouts installed as necessary to provide for proper drainage along the access road routes and in accordance with EOG's Storm Water Management Plan. Construction activity would not be conducted using frozen or saturated soils materials or during periods when watershed damage is likely to occur.

In the event that commercial production is established from the subject wells, the access roads would be surfaced to an average minimum depth (after compaction) of four inches, with three-inch minus pit run gravel or crushed rock, if required by the Authorized Officer (AO). Materials would be obtained from a contractor having a permitted source within the general area, such as those listed in **Table 2.2.1.1-2**.

The access roads and associated drainage structures would be constructed and maintained in accordance with road guidelines contained in the SAA and in the joint BLM/USFS publication *Surface Operating Standards for Oil and Gas Exploration and Development*, Fourth Edition, and/or BLM Manual Section 9113 (BLM 2011a), as applicable. During the drilling and production phase of operations, the road surface and shoulders would be kept in a safe and useable condition and drainage ditches and culverts would be kept clear and free flowing.

If the access roads are dry during construction, drilling, and completion activities, water would be applied to the access roads to help facilitate road compaction (during construction), provide dust abatement, and minimize soil loss as a result of wind erosion. Refer to **Section 2.2.3** for more details regarding water usage.

2.2.2 Well Development

2.2.2.1 Well Drilling

Following construction, drilling rigs would be transported to the well site and erected on the well pad. Current technology may allow each rig to drill 30 wells each year, depending on the formation. Approximately two rigs are anticipated to be operating in the Project Area. The actual number of rigs in the Project Area would be dependent on numerous factors.

All equipment and vehicles associated with drilling activities would be confined to the approved disturbance areas of the roads and well pads. Wells would be drilled and completed in accordance with WOGCC rules and regulations, BLM Onshore Oil and Gas Order No. 2, and other current BLM guidelines. Detailed well construction plans would be included in the APD for any given well.

Horizontal wells would be drilled vertically from each surface location to a pre-determined point above the target formation, referred to as the "kickoff point." From here, the wellbore would curve its vertical trajectory to intersect the target reservoir at the "entry point," then continue horizontally through the reserve until reaching the desired bottom-hole location.

Wells would be drilled to varying total measured depths (approximately 16,000 feet to 20,000 feet) to the Turner and Parkman formations. Other formations of interest such as the Mowry, Niobrara, Shannon, and Sussex occur within the geologic vicinity of the target formations. Drilling would determine whether oil and gas production could be established. As soon as evaluation of the production intervals is conclusive, any unproductive drill holes would be pulled and abandoned in accordance with state and Onshore order requirements.

EOG would use closed-loop drilling methods for all of the proposed wells and therefore no open reserve or cuttings pits would be needed. The closed-loop system would consist of above-ground storage tanks for the containment of drill cuttings and two to three 500-barrel (bbl) upright tanks for the containment of drilling and completion fluids. The storage area for these tanks would include a plastic liner and containment berms. Liners would be installed under mud tanks and any tanks used for the storage of oil based cuttings. Berms would be installed around the oil-based system and any tanks used for oil-based mud storage. The drilling rig would also set atop a plastic liner. The closed-loop system would include a divider and would be lined with a 16-mil liner.

The closed-loop system would be constructed to minimize the accumulation of surface precipitation runoff into the cuttings tanks containment area. This may be accomplished by appropriate placement of subsoil/topsoil storage areas and/or construction of berms or ditches. The closed-loop system would be fenced on three sides during drilling operations and the fourth side would be fenced after the drilling rig moves off the location. This fence would be either: (1) woven wire at least 28 inches high and within four inches of ground surface with two strands of barbed wire above the woven wire with 10-inch spacing, or (2) at least four strands of barbed wire spaced, starting from the ground, at approximately 6-, 8-, 10-, and 12-inch intervals.

Siphons, catchments, drip pans, and absorbent pads would be installed to keep hydrocarbons produced by the drilling and/or completion rigs from entering the closed-loop system. Hydrocarbons and contaminated pads would be disposed of in accordance with WDEQ requirements (see **Section 2.2.4**, *Waste Disposal*).

During drilling operations, a blowout preventer would be installed on the surface casing to provide protection against uncontrolled entry of reservoir fluids into the wellbore in the event that reservoir pressures exceed the hydrostatic pressure of the wellbore fluid. In addition, a flow control manifold consisting of manually and hydraulically operated valves would be installed at ground level. All pressure-control devices would comply with the provisions of BLM's Onshore Oil and Gas Order No. 2.

The casing and cementing program would be designed to protect wellbore integrity, isolate, and protect the shallower formations encountered in the wellbore, and prohibit pressure communication or fluid migration between zones. In addition, the cement would protect the well by preventing formation pressure from damaging the casing and retarding corrosion by minimizing contact between the casing and formation fluids. EOG may also run downhole evaluation logs prior or subsequent to setting and cementing production casing. Detailed site-specific casing and cementing plans for each well would be included with each federal APD package and approved by a BLM and/or state petroleum engineer.

2.2.2.2 Completion Operations

Completion operations would commence after a well is drilled and the potential well productivity has been determined. Completion operations would consist of hydraulically fracturing the producing formation. A water/sand slurry would be used with gels and other additives to ensure the quality of the fracture fluid. Slurry would be pumped down the well bore through perforations in the casing and into the formation. Pumping pressures and slurry flow rates would be increased to the point at which fractures propagate outward from the perforations into the formation and the slurry flows rapidly into the factures. The sand serves as a proppant to keep the created fracture open after the pressure drops, thereby allowing reservoir fluids to move more readily into the well.

Hydraulic fracturing is used on potentially productive reservoirs at depths below usable aquifers. Hydraulic fracturing processes and required disclosures would be conducted in accordance with all current and future WOGCC, BLM, and any other applicable rules. The WOGCC requires operators to disclose the types and amounts of hydraulic fracturing chemicals used prior to stimulation (WOGCC 2010). EOG would also disclose the contents of hydraulic fracturing fluid used in the proposed wells to the public through FracFocus, a website managed jointly by the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission (http://fracfocus.org). In addition, EOG would comply with the USEPA requirements at 40 CFR Part 60, Subpart OOOO that require notification two days prior to completion of any gas well that will include hydraulic fracturing.

EOG would utilize "green completion" on new wells to limit the venting or flaring of natural gas. According to Wyoming Air Quality Standards and Regulations (WAQSR) Chapter 6, Section 2, Oil and Gas Production Facilities Permitting Guidance (September 2013), wells located in Converse County are not required to utilize "green completions." However, all gas well completions with hydraulic fracturing must follow specific "green completion" guidelines according to 40 CRF Part 60, Subpart OOOO. Under Subpart OOOO, these wells must recover liquids during flowback and route to storage tanks or re-inject them. All

recovered gas shall be re-routed, used, or put into a collection system with no direct release to the atmosphere. Only if recovered flowback gas cannot be put to a gas flow line, may it be captured or flared.

Economically viable wells would be connected to permanent production facilities (for additional details refer to **Section 2.2.2.3,** *Well Pad Production Equipment*) and wells would be turned to production through those facilities. Post stimulation flow tests would allow for recovery of stimulation fluids and evaluation of well productivity. Recovered fluids would include variable amounts of produced water in addition to stimulation fluids. Flow testing duration would vary depending on individual well performance, but typically would be conducted only long enough for fluid rates to drop to a level that permanent production equipment can safely process. Portable and/or permanent production equipment would be utilized to separate fluids from the flow back stream, allowing recovered fluids to be directed to storage tanks. Fluids recovered during flow back operations would be transported from the storage tanks to an approved disposal facility. Oil would be contained in tanks and ultimately sold.

Wells drilled into the Turner formation would not be flared. Instead, they would be shut in until connected into a pipeline. Wells drilled into the Parkman Formation would typically be flared for up to 14 days after initial production, and then EOG would either secure a permit to continue flaring or shut in the well until connected to pipeline. If there is an emergency upset in the gathering system, EOG would be authorized to flare gas under WOGCC Chapter 3 Section 39. If a shutdown is longer than 24 hours, EOG would be required to secure a permit to flare over the shutdown period or to the maximum volume that the state allows. In addition, in accordance with the US DOI NTL-4A memo, "Royalty or Compensation for Oil and Gas Loss," EOG would be authorized to flare gas without incurring a royalty obligation in an emergency situation. Under Part III of the memo, Authorized Venting and Flaring of Gas, a temporary emergency situation would be authorized for up to 24 hours per incident, and up to 144 hours during any calendar month. All other applicable requirements within the NTL-4A memo or future regulations would be followed as well.

Completion operations for an individual well could require from four to 30 people, who would access the well pad with two to 20 vehicles. Depending on the formation, an individual well could be stimulated and completed on average in 17 days (or 90 days per well pad), which is consistent with what is assumed for completion timeframes in the Air Quality Emissions Inventory (**Appendix D**).[1]

If a well is determined to be non-productive, the well would be completed as a dry hole. In accordance with 43 CFR 3160, a Well Completion Report and Log (Form 3160-4) would be submitted within 30 days after completion of each well or after completion of well operations being performed.

2.2.2.3 Well Pad Production Equipment

If production is established for the proposed wells, production facilities would be installed on each well pad. These facilities may include the following:

- Between four and 16 400-barrel oil tanks
- Between one and four 400-barrel produced water tanks

[1] Completion timeframe based on estimates provided by EOG for the Parkman, Turner, and Mowry formations.

- Between one and four 400-barrel emergency tanks
- Between one and four six-inch by 20-inch combo vertical heater treater/dehydrators approximately 8 by 12 by 16 feet in size for a four-well pad.

Once a well is producing, a Lease Operator would visit each location daily to monitor the production facilities, gauge fluid levels, and ensure that all equipment is functioning properly. Daily visitation would be required to monitor the production facilities, gauge fluid levels, and ensure that all equipment is functioning properly. While telemetry would aid in monitoring production and reduce truck traffic, some or all sites may require daily visitation depending on site conditions. All safety measures would be considered in the design, construction, operation, and maintenance of production facilities. EOG would have a designated representative present during construction. Any accidents to persons or property would be immediately reported to the AO.

All production facilities would be located on the disturbed portion of the well pad and a minimum of 25 feet from the toe of the back slope of the pad. Aboveground structures on site for six months or longer would be painted Covert Green 18-617TPX, unless subject to safety requirements requiring another color.

Containment berms would be constructed completely around production facilities designed to hold fluids (i.e., production tanks, produced water tanks, and/or heater/treater). The containment berms would be constructed of compacted subsoil, be sufficiently impervious, hold 110 percent of the capacity of the largest tank, and be independent of the back cut.

All equipment would be powered by a 100 to 200-kilowatt generator on each pad, depending on the number of wells. The generator would be fueled by natural gas produced from the wellhead. The noise level from the generator would be approximately 100 decibels (dB) at 50 feet. This value may vary due to varying load levels on the generator. If production from wells developed as a result of this EA is sufficient and utility lines and pipelines are feasible, EOG will propose these ROWs via the BLM's sundry process. The use of electrical utility lines and water and natural gas pipelines will also be analyzed within the Greater Crossbow EIS.

2.2.3 Water Requirements

Water requirements for construction, drilling, completion, and dust abatement are summarized in **Table 2.2.3-1**. Each well would require approximately 3,500 bbl of water to perform drilling operations using a combination of water-based and oil-based drilling fluids. Approximately 150,000 to 300,000 bbl of water would be required to complete a horizontal well, depending on the number of stimulations required. The total volume of water per well for drilling and completion operations is approximately 153,500 to 303,500 bbl, and the total volume of water needed for the Proposed Action Alternative is between 7,214,500 and 14,264,500 bbl.

Table 2.2.3-1. Water Sources Requirements for the Proposed Action Alternative

Project Phase/Task	Project Feature	Water Volume (bbl)
Dust Abatement During Construction	Per Well Pad	1,200
	Per One Mile of Access Road	1,500
Drilling	Per Well	3,500
Completion	Per Well	150,000 to 300,000
Dust Abatement During Production	Per One Mile of Access Road	1,500

Water for drilling, completion, and dust abatement would be obtained from approved and WDEQ permitted sources. EOG's existing water wells are presented in **Table 2.2.3-2**. Additional water may be obtained from a municipal water source, if needed. A water appropriation permit has been obtained through the State of Wyoming Office of the State Engineer. Water would be hauled by truck from State Highway 59 following approved access routes to the location.

Table 2.2.3-2. Water Sources for the Proposed Action Alternative

Well Name	Well Location
Arbalest 1-13	Section 13 T41N R72W
Crossbow 1-07	Section 7 T41N R71W
Reno 1-01	Section 7 T41N R72W
Municipal water source	Multiple permits

2.2.4 Waste and Hazardous Materials Management

Cuttings and drilling fluids from water based mud would be contained within the closed-loop system. Further discussion on the closed-loop system was presented in **Section 2.2.1.1**, *Well Drilling*. Fracture stimulation fluids would be flowed back into above-ground tanks and hauled to a WDEQ authorized disposal site.

Produced wastewater would be confined to a storage tank for a period not to exceed 90 days after initial production. After the 90-day period, the produced water would be disposed of at one of the following permitted locations: McBeth Water Disposal, North Douglas Water Disposal, Lynch Water Disposal, or the North Bill Disposal.

A portable toilet would be provided for human waste during the drilling and completion of the well. Disposal will be at an authorized site. All garbage and non-flammable waste materials would be stored in a self-contained portable dumpster or trash cage on location. Immediately after removal of the drilling rig, all debris and other waste materials not contained in the trash cage would be cleaned up and removed from the location. No potentially adverse materials or substances would be left on the location. Upon completion of operations, or as needed, the accumulated trash would be transported to a state approved waste disposal site.

EOG's basin head office in Douglas, WY maintains a file, per 29 CFR 1910.1200 (g) containing current SDS for all chemicals, compounds, and/or substances that are used during the course of construction, drilling, completion, and production operations. Hazardous materials that may be found at the site may include drilling mud and cementing products that are primarily inhalation hazards, fuels (flammable and/or combustible), and materials that may be necessary for well completion and stimulation activities such as flammable or combustible substances and acids/gels (corrosives). The opportunity for Superfund Amendments and Reauthorization Act (SARA) listed Extremely Hazardous Substances (EHS) at the site is generally limited to proprietary treating chemicals. All hazardous and EHS and commercial preparations would be handled in an appropriate manner to minimize the potential for leaks or spills to the environment.

2.2.5 Reclamation

Reclamation emphasizes the eventual ecosystem reconstruction in order to return the land as close as possible to a pre-disturbance conditions. Reclamation procedures include interim reclamation that would quickly stabilize disturbed areas to protect those areas not needed for production from unnecessary degradation. Final reclamation, taking place after the lifetime of the well, would return the vegetation and soils in the areas of disturbance to pre-disturbance condition.

EOG would perform reclamation activities in conformance with the preferences of the appropriate surface management agency (SMA) or private surface owner. In addition, EOG would comply with the Wyoming Reclamation Policy as currently expressed in BLM Wyoming Instruction Memorandum 2012-032 (4/2/12). EOG's reclamation strategy would remain adaptive to address results from ongoing monitoring and would implement advances in reclamation. EOG's reclamation strategy would include:

- Developing procedures and strategies to ensure successful interim and final reclamation operations in the Project Area;
- Modifying procedures and strategies as needed throughout the life of the Project;
- Developing procedures for reclamation monitoring and reporting; and
- Evaluating reclamation performance on an ongoing basis in terms of successful site stabilization.

2.2.5.1 Interim Reclamation

Within 30 days of completing the well construction, drilling, and completion phases of development, EOG would begin soil stabilization for the production phase of the project site. Within six months of finalizing the well construction, drilling, and completion phases of the proposed project, all surfaces not needed for the production phase would undergo interim reclamation, weather permitting. Rat and mouse holes would be filled and compacted from bottom to top immediately upon release of the drilling rig from the location. EOG would use various methods such as matting and/or seeding to stabilize the topsoil stockpiles. Topsoil from the berms and/or storage piles would be spread along the access road's cut and fill slopes. Drainage ditches or culverts would not be blocked with topsoil and associated organic matter. The unused area of the pad would be re-contoured and topsoil spread six inches deep. The area on the contour would be mechanically ripped one foot deep using ripper teeth set on one-foot centers. The top soil areas and reclaimed area of the well pad would be seeded as stated below.

All disturbed areas would be seeded using a drill equipped with a depth regulator. All seed would be drilled on the contour and planted between one-quarter and one-half-inch deep. Where drilling is not possible (i.e., too steep or rocky), the seed would be broadcast and the area raked or chained to cover the seed. If the seed mixture is broadcast, the rate would be doubled. EOG would use a seed mixture and application rate approved by the landowners. An example BLM recommended seed mixture is provided in **Table 2.2.5.1-1**.

Table 2.2.5.1-1. Example Fee Surface Seed Mixture

Common Name	Scientific Name	Application Rate (Pounds [lbs] Live Seed per Acre)
Thickspike wheatgrass	*Elymus lanceolatus* ssp. *lanceolatus*	3.0
Prairie sandreed	*Calamovilfa longifolia*	4.0
Indian ricegrass	*Achnatherum hymenoides*	3.0
Green needlegrass	*Nassella viridula*	1.0
Prairie coneflower	*Ratibida columnifera*	0.5
Blue flax	*Linum lewisii*	0.5
Total		**12.0**

* The seed mixture may change due to landowner request as surface disturbance is located on private surface.

Seeding would be done either in late autumn (September 15 to November 15), before freeze up and after completion activities, or as early as possible the following spring to take advantage of available ground moisture. The seeding would be repeated until a satisfactory stand, as determined by the landowner, is obtained. The first evaluation of growth would be made following completion of the first growing season after seeding.

2.2.5.2 Final Reclamation

Once a well is removed from production, the following activities would occur:

1. All waste materials or contaminated soils would be treated and moved off-site to an authorized disposal facility.
2. All drill holes would be properly filled and compacted and BMPs would be put in place to protect surface and groundwater.
3. Configuration of the re-shaped topography would be returned, as near as possible, to the original condition. Cut and fill slopes would be at a ratio of 3:1 or less. All topsoil would be re-stripped from interim reclamation and redistributed over the entire location. The entire location would be scarified 12-inches deep at eight-inch intervals. Water bars would be constructed at an eight percent grade.
4. Drainage features and water courses would be returned, as near as possible, to the original condition to approximate the natural features found in nearby naturally functioning basins.
5. EOG would use various methods such as matting and/or seeding to stabilize the topsoil stockpiles. Topsoil from the berms and/or storage piles would be spread along the road's cut and fill slopes. Drainage ditches and culverts would not be blocked with topsoil and associated

organic matter. The unused area of the pad would be re-contoured and topsoil spread six inches deep.

6. All disturbed areas would be seeded using a drill equipped with a depth regulator. All seed would be drilled on the contour. The area on the contour would be ripped one foot deep using ripper teeth set on one-foot centers to accommodate desired plant species. The seed would be planted between one-quarter and one-half inch deep. Where drilling is not possible (i.e., too steep or rocky), the seed would be broadcast and the area raked or chained to cover the seed. If the seed mixture is broadcast, the rate would be doubled. EOG would use a seed mixture and application rate approved by the landowners. An example BLM recommended seed mixture is provided in **Table 2.2.5.1-1**. The seed mixture may change due to landowner request as surface disturbance is located on private surface.
7. Seeding would be done either in late autumn (September 15 to November 15), before freeze up and after completion activities, or as early as possible following spring to take advantage of available ground moisture.
8. Configuration of the re-shaped topography would be returned, as near as possible, to the original condition. The seeding would be repeated until a satisfactory stand, as determined by the landowner, is obtained. The first evaluation of growth would be made following completion of the first growing season after seeding.
9. Invasive plants would be identified before surface-disturbing activities. Weeds would be controlled on disturbed areas within the exterior limits of the access road and well pad. The control methods would be in accordance with guidelines established by the USEPA.
10. Monitoring would be conducted by a qualified Operator representative (in coordination with the BLM) following initial rehabilitation work. Monitoring areas would be re-examined at the end of the first growing season. Problem areas identified during monitoring would receive follow-up rehabilitation/erosion control measures. The seeding would be repeated until a satisfactory stand, as determined by the landowner, is obtained.

2.2.5.3 Control of Invasive/Noxious Weeds

Invasive plants would be identified before surface-disturbing activities. Weeds would be controlled on disturbed areas within the exterior limits of the access road and well pad. The control methods would be in accordance with guidelines established by the USEPA, BLM, state, and local authorities. Approval would be obtained from the AO prior to use of pesticides.

Reclamation monitoring would be conducted by a qualified Operator representative (in coordination with the BLM, as applicable) following initial rehabilitation work. Monitoring areas would be re-examined at the end of the first growing season to evaluate reclamation success and identify the presence of any noxious and/or invasive species. Areas with inadequate reclamation success or invasive plant infestations identified during monitoring would receive follow-up rehabilitation/ erosion control measures. Seeding would be repeated until a satisfactory stand, as determined by the landowner and outlined in the SUA, is obtained.

2.2.6 Timing and Workforce Requirements

Construction, drilling, and completion operations are anticipated to require 143 to 163 days per well pad. The number of days required to complete each location may be more or less and would vary based upon

the presence of existing construction, the number of wells to be drilled on the location, and the distance/availability of the drilling rig. Details regarding the approximate duration of each Project activity is provided in **Table 2.2.6-1.**

Table 2.2.6-1. Construction, Drilling, and Completions Schedule

Project Activity	Approximate Duration
Construct Pad and Access Road	10-15 days
Mobilize Drilling Rig[a]	5-8 days
Drilling (24-hour operations)	8-20 days
Schedule/Logistics for Completion	30 days
Completion (setup, completion, facility construction and demobilization)	90 days

[1] Depending on distance and need to add supplemental drilling equipment, such as skidding plates.

On average, the workforce needs for construction activities would be one five-person crew per well pad per month. Workforce needs for drilling and completing an individual well could average 10 people, but could vary from five to 25 people per well. The production phase would require a minimal workforce.

2.2.7 Surface Disturbance Summary

Construction associated with the Proposed Action Alternative would result in approximately 110.157 acres[2] of initial surface disturbance. Interim site reclamation would be completed for portions of the well pad not required for production activities within six months of well completion, weather permitting.

2.2.8 Applicant-Committed Environmental Protection Measures

Under the Proposed Action Alternative, Applicant-Committed Environmental Protection Measures (ACEPMs) would be implemented by EOG to alleviate or reduce the potential short-term, long-term, and cumulative impacts of the Project to the natural and human environment within the Project Area. **Sections 2.2.8.1 – 2.2.8.8** describe these resource-specific measures, which incorporate several design features, federal and state requirements, BMPs, and conservation measures. Project activities would also follow practices and procedures outlined in the appropriate land use plan, each individual APD, and any Conditions of Approval (COAs) appended by the SMA. Additional mitigation measures identified for the Proposed Action Alternative are discussed for each resource in **Chapter 4**, *Environmental Effects*.

The implementation of some ACEPMs may be dependent on landowner approval or may be subject to limitations outlined in a specific SAA. Additionally, the term feasible in the context of this proposal is defined as "situations in which compliance with the measures outlined would add such additional expense to the well that the costs of drilling, completing, and operating such a well would yield a rate of return under

[2] As presented in **Table 2.2.1.1-1**, total acreage estimates are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development and minute boundary discrepancies. GIS-based calculations are considered more accurate than estimates calculated using simple addition and therefore will be utilized throughout this document, wherever possible.

which a prudent operator would elect not to drill such a well". As feasible and authorized, the following Project design features would be used for all locations in the Project Area:

2.2.8.1 Air Quality

- EOG would use water and/or water with commercial suppressants for dust abatement on access roads, if needed and in accordance with the preference of the private surface owner.
- All production equipment at well sites and at the centralized facilities would be fitted with low-bleed or electric valves. The potential use of electric valves would result in a reduction in emissions.
- Production tank venting emissions would be minimized through the use of combustors.
- Truck traffic would be reduced through the use of Primary Corridors.
- EOG would use well head telemetry for remote monitoring once a well is in production to reduce maintenance traffic.

2.2.8.2 Soils

- EOG would use grading, site preparation BMPs, and other soil retention measures to mitigate potential soil losses and other erosive forces.
- EOG would design all well pads to prevent stormwater and sheet flow from entering the well pad.
- EOG would apply 30-day stabilization measures for all sites following the completion of the construction, well drilling, and completion phases of each location. In cases where the ground is covered by snow or frozen, site stabilization may extend outside of the 30-day period following construction. In these instances site stabilization will be done as soon as practicable.
- EOG would modify reclamation procedures and strategies as needed and would evaluate reclamation performance on an ongoing basis in terms of successful site stabilization.
- Although not required on non-federal lands, EOG construction operations (e.g., access roads) would conform to standards described in the Gold Book (BLM and USFS 2007).
- Construction on steep slopes greater than 25 percent would be avoided, where feasible.

2.2.8.3 Water Resources, Including Surface and Groundwater Quality, Hydrologic (Stormwater) Conditions, Floodplains, and Waters of the United States

- EOG would re-use drilling mud for new wells to the maximum extent possible.
- EOG would incorporate site-specific BMPs to control stormwater runoff, including appropriate measures to prevent sedimentation.
- All construction and maintenance activities would cease if soils or road surfaces become saturated to the extent that construction equipment is unable to stay within the disturbance corridor or Wyoming temporary use permit, and before activities cause irreparable harm to roads, soils, or excessive siltation of nearby reservoirs or live flowing streams.

2.2.8.4 Vegetation, Including Grassland and Shrubland Communities, Riparian and Wetland Communities, Invasive and Nonnative Plant Species, Pest Control, and Special Status Species

- EOG would control invasive and noxious weeds along well pads, access roads, and other facilities as specified by the surface owner, County, State, and BLM regulations. A list of noxious weeds would be obtained from the BLM or appropriate County Extension Office.

2.2.8.5 Fish and Wildlife, Including Special Status Species

- When siting facilities, EOG would use the results of annual raptor nest surveys and other available data to avoid impacts to active nests. For instance, during onsites, the Blade 18 NENW well pad was removed from EOG's proposal due to the pad's proximity to a golden eagle nest. The Mary's Draw 8 SESW well pad would have tanks placed in a location that would serve as visual barrier to golden eagle nests located 0.5 mile north of the well pad. For additional information on site-specific avoidance, minimization and mitigation measures for raptors, refer to **Appendix B**.
- When staking a well pad, EOG would use a biological monitor to ensure no line-of-sight impacts to any active nests that may have been built after the annual survey.
- EOG would install bird-excluding devices that prevent the perching and entry of migratory birds on or into new fired vessel exhaust stacks in nesting habitat of high-priority bird species.
- EOG would use closed-loop drilling systems. All produced water would be contained in closed, above-ground tanks.
- EOG would implement standards to minimize impacts to birds and other wildlife from its operations including keeping open top containers free of liquids harmful to wildlife, promptly cleaning up liquids harmful to wildlife, and routinely inspecting open-top containers.
- EOG would conduct annual inspections of avian protection measures for vessels, containers, tanks, etc. during SPCC inspections of well sites. Any deficiencies would be documented and repaired as soon as possible. Lease operators would be advised to continually monitor locations for maintenance issues including avian protection measures.
- Exhaust stacks greater than two inches in diameter on fired vessels (e.g., line heaters and heater-treaters) and vent stacks on non-fired vessels would be fitted with bird exclusion devices. Active compressor engine exhaust stacks are not required to have exclusion devices; however, if a compressor is scheduled to be shut down for an unknown period of time, an exclusion device would be installed.
- EOG would ensure that other openings on vessels are equipped with screens or other appropriate equipment to prevent entry by wildlife, including migratory birds.
- EOG would keep equipment with burners closed during maintenance activities and during non-operational times.
- Netting, screening, or other avian-exclusion devices would be installed on all open-top oil, condensate, and produced water tanks, and any other open-top container that may contain liquids harmful to wildlife. Netting or screens would be inspected periodically for rips, tears, or evidence of contact with tank contents, especially after heavy precipitation events.
- Covers, wire mesh, or other materials would be placed on small containers (55 gallons or less) that are left open while in use under valves or spigots to catch drips.
- Open-top tanks that do not contain harmful substances (e.g., stock water tire tanks) would be equipped with escape ramps to minimize the potential drowning of migratory birds.
- All secondary containment for chemical storage would have exclusionary devices or would be inspected routinely and, if standing fluid is found, it would be removed promptly.

2.2.8.6 Cultural Resources

- If historic or archaeological materials are uncovered during construction, EOG would immediately stop surface-disturbing activities that might further disturb such materials and contact the surface owner or AO.
- All EOG personnel would refrain from collecting artifacts and from disturbing any NRHP-eligible cultural resources in the area. EOG would be responsible for informing all persons in the area who are associated with this Project that they may be subject to prosecution for knowingly disturbing historic or archaeological sites or for collecting artifacts. All vehicular traffic, personnel movement, construction, and restoration activities would be confined to the areas examined, as referenced in the archaeological report, and to the existing roadways and/or evaluated access routes.

2.2.8.7 Livestock and Grazing

- EOG would install cattle guards at all fence crossings (unless requested otherwise by the landowner).

2.2.8.8 Health and Safety

- EOG would restrict public access to facilities that may endanger the public. In consultation with the surface owner or AO, EOG would install "warning" signs at locations where public access could result in potential safety issues.

2.2.8.9 Ongoing Studies

EOG has invested a considerable amount of time and funding into baseline environmental studies for wildlife and cultural resources in the Project Area. Information from these studies may be used to inform this EA, as well as future planning efforts associated with the ongoing Greater Crossbow EIS.

2.2.8.9.1 Wildlife Resources

- *Ferruginous Hawk Study* – In a collaborative study with the BLM and Wyoming Game and Fish Department (WGFD), EOG has funded Hayden-Wing Associates, LLC. (HWA) of Laramie, WY, to assist in a study that is collecting information on movement patterns, territory characteristics, and habitat use by ferruginous hawks (*Buteo regalis*). For this study, HWA collared and tracked four ferruginous hawks in 2014 using a Global Positioning System (GPS) transmitter. This study was expanded in 2015 to collar and track a total of six ferruginous hawks (five males and one female).Data from this study are being used to contribute to an understanding of ferruginous hawk habitat use, territory size, selection/avoidance of landscape features, migratory patterns, and wintering ecology of the population in in the PRB and potentially Wyoming. While all of the findings of this study may not be complete in time for implementation in the Proposed Action for this Project, the findings could be used to better inform planning and decision making processes for the ongoing EIS, while also contributing to a broader understanding of ferruginous hawk breeding ecology in WY.
- In addition, HWA has been collaborating with a separate ongoing research project being conducted by Dr. John Squires (Rocky Mountain Research Station [RMRS] and Robert Oakleaf (recently retired from the WGFD). Essentially, the planned fieldwork and trapping/tagging efforts was

consolidated between the two projects in 2014, using a common study area, to avoid overlapping efforts and unnecessary disturbance to nesting ferruginous hawks. The results of the study will be used to help inform the ongoing EIS, as well as future planning efforts.

- *Raptor Survey and Biological Resource Study* – EOG has funded HWA to conduct annual raptor nest inventories and other biological surveys (e.g., habitat assessments for Ute ladies'-tresses).

3.0 AFFECTED ENVIRONMENT

This chapter describes the resources of the human and natural environment that may be affected by the No Action Alternative or Proposed Action Alternative. Those environmental resources elements that are not present within the Project Area and other environmental elements, if present, that may be minimally affected or not affected by the alternatives were dismissed. Rationale for the inclusion of dismissal of resource elements is provided in **Appendix A**, *Affected Resources Checklist*.

For the purpose of describing the affected environment, the Project Area is a 24,285-acre area in Converse County, WY. Details regarding the surface ownership and administration were presented in **Section 1.2**, *Background*.

3.1 AIR QUALITY

Regional air quality is influenced by a combination of factors including climate, meteorology, the magnitude and spatial distribution of air pollution sources, and the chemical properties of emitted pollutants. Within the lower atmosphere, regional and local scale air masses interact with regional topography to influence atmospheric dispersion and transport of pollutants. The following sections summarize the climatic conditions and existing air quality within the Project Area and surrounding region.

3.1.1 Climate

The Project Area is located in the southern extent of the Powder River Basin (PRB) and includes portions of northern Converse County in northeast Wyoming. The PRB is bounded by the Black Hills to the east; by Casper Arch, Laramie Range, and Hartville Uplift to the south; and by the Big Horn Mountains to the west. The area is located in a semiarid region (dry and cold) with long, cold winters and short summers. Elevations within the Project Area range from approximately 4,500 feet above mean sea level (amsl) to 5,500 feet amsl. The Project Area falls within the PRB and Great Plains physiographic provinces and is located within the Antelope Creek drainage system.

3.1.2 Temperature and Precipitation

The closest meteorological station to the Project Area with a complete and current climatic record is located in Wright, Wyoming (WRCC 2015). The Wright station is located approximately 10 miles north of the Project Area, at an elevation of 5,121 feet amsl. **Table 3.1.2-1** summarizes the mean temperature range, mean total precipitation, and mean total snowfall data by month from July 1991 to January 2015 (WRCC 2015).

The annual mean precipitation at Wright is 13.7 inches, and ranges from a minimum of 10.1 inches recorded in 2004, to a maximum of 21.1 inches recorded in 1998. On average, December is the driest month of the year with a monthly mean precipitation of 0.4 inches, and May is the wettest month with a monthly mean precipitation of 2.54 inches. The annual average snowfall is 56.6 inches, with April being the snowiest month. A record annual snowfall of 80.6 inches was recorded in 1993 (WRCC 2012a).

The annual mean temperature at Wright is 44.5 degrees Fahrenheit (ºF). Average seasonal winter temperatures range from about 13.4º F to 35.0 º F, while average summer temperatures range from 51.1º F to 81.8º F. Recorded daily extreme temperatures are minus 39º F in 1996 and 103º F in 2006 (WRCC 2012b).

Table 3.1.2-1. Temperature, Precipitation, and Snowfall Data at Wright, Wyoming

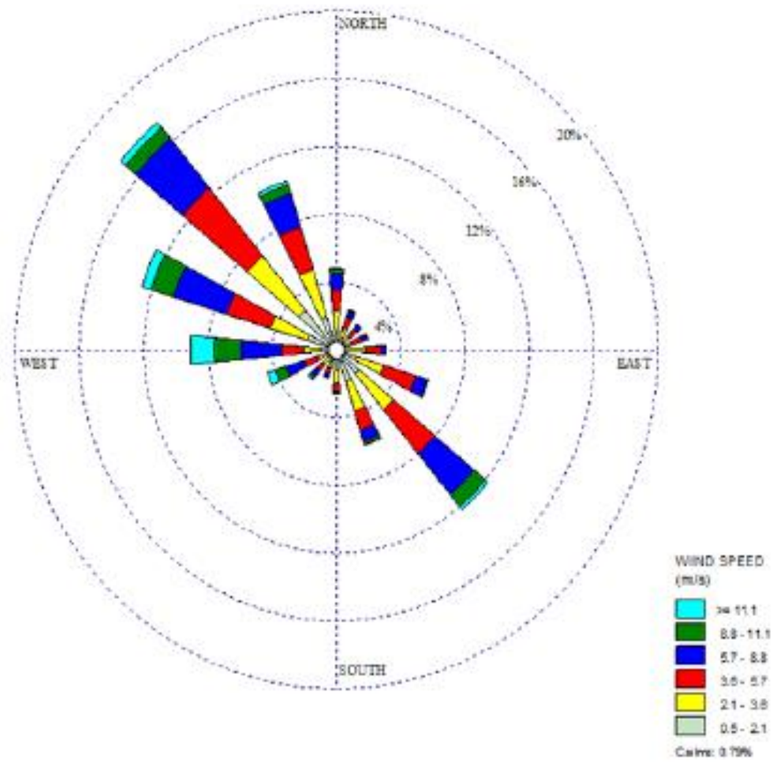
Month	Average Temperature Range (in degrees Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
January	12.7-34.2	0.40	6.7
February	14.6-36.6	0.48	7.2
March	22.1-46.7	0.96	9.4
April	29.2-54.6	1.63	9.9
May	37.9-64.4	2.54	2.5
June	46.4-74.9	1.93	0.3
July	54.2-85.8	1.48	0.0
August	52.7-84.7	0.81	0.0
September	42.9-73.0	1.06	0.7
October	31.4-58.1	1.43	6.1
November	21.0-43.4	0.56	7.0
December	12.9-34.3	0.39	6.8
Totals	**31.5-57.5 (annual average)**	**13.67**	**56.6**

Source: WRCC 2015. Data collected at Wright, Wyoming from 7/1/1991 to 1/20/2015.

3.1.3 Winds and Atmospheric Stability

According to the WDEQ, the nearest and most complete wind speed and direction data set that is suitable for air quality impact modeling analyses and representative of the Project Area, is the Automated Surface Observing System meteorological tower at the Douglas-Converse County Airport located approximately 50 miles south of the geographic center of the Project Area, near Douglas, WY,. Upper-air data consisting of twice-daily soundings from the nearest upper-air monitoring station (Riverton, WY) are available along with the surface data at the airport. **Figure 3.1.3-1** illustrates a wind rose that depicts wind speed and direction based on 5 years of data collection (2008 through 2012) at Douglas-Converse County Airport (WDEQ-AQD 2014a). Note that the data represents the direction from which the wind is coming. As shown in **Figure 3.1.3-1**, winds originate predominately from the northwest. The average measured wind speed is 10.54 miles per hour (4.71 meters/second). Although local terrain effects influence the wind profiles specific to the Project Area, data from the Douglas-Converse County Airport Station are considered to be representative of the Project Area.

Wind speed and direction are important to the dilution and transport of air pollutants. Wind direction determines where the air pollutants are transported, and based on the Douglas-Converse County Airport wind rose, air pollutants are transported in a southeast direction within and near the Project Area. Wind speed impacts the concentration of air pollutants because dispersion increases with increasing wind speeds, thereby decreasing air pollutant concentrations at individual receptors.



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PROJECT NO:	20154640.001A
DRAWN:	12/15/2015
DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	3.1.3-1_AirportWindRosePlot.mxd

Crossbow 2016 Interim Drilling EA
Wind Rose Plot from 2008 to 2012
at the Douglas-Converse County Airport

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.1.3-1

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The degree of stability in the atmosphere is also a key factor in dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited and the dispersion of pollutants is inhibited. Conversely, during unstable conditions, upward and downward movement in the atmosphere prevails, and dispersion of pollutants in the atmosphere is enhanced. Temperature inversions (when temperatures increase with height) can result in very stable conditions with virtually no vertical air motion. The Project Area will typically have more large-scale temperature inversions in the winter rather than in the summer due to colder stable air masses settling closer to the ground. Afternoons in the Project Area typically have increasing instability due to warming.

3.1.4 Visibility

Haze is a form of air pollution that occurs from refraction of sunlight on particles in the atmosphere (USEPA 2015a). The result of haze is impaired visibility conditions. In 1999, the USEPA published the Regional Haze Rule implementing a visibility protection program for certain areas, such as national parks and wilderness areas, classified as Class I areas. Class II areas include land owned by the BLM that has less restrictive visibility requirements. The Interagency Monitoring of Protected Visual Environments (IMPROVE) database collects daily and weekly visibility and air pollutant concentration data from monitoring sites in and near Class I areas across the country (IMPROVE 2015). The nearest IMPROVE monitors near the Project Area are listed below in **Table 3.1.4-1** along with their approximate distance and direction from the Project Area. The Northern Cheyenne visibility monitor is in a federal Class II area, however under Tribal jurisdiction, the area is considered a Class I area.

Table 3.1.4-1. Nearest IMPROVE Monitors to the Project Area

Nearest Visibility Monitors	Approximate Distance from Project Area	Approximate Direction from Project Area	CAA Status (Class I or Class II)
Thunder Basin Wilderness Area	80 miles	NNW	Class II
Cloud Peak Wilderness Area	90 miles	WNW	Class II
Wind Cave National Park	100 miles	E	Class I
Northern Cheyenne	160 miles	N	Class II
Badlands National Park	175 miles	E	Class I

The Thunder Basin Wilderness Area and the Cloud Peak Wilderness Area are the nearest IMPROVE monitors that provide approximate visibility conditions in the Project Area. A light extinction coefficient is a way to describe changes in visibility due to changes in concentrations of air pollutants. A Koschmieder Coefficient is a way to describe how the human eye sees contrasts. Visual range can be calculated as the Koschmieder Coefficient divided by the light extinction coefficient. Data for the total light extinction coefficient was downloaded from the IMPROVE network site (IMPROVE 2015). The total light extinction coefficients recorded at both IMPROVE monitoring stations were used to derive the standard visual range at the Thunder Basin and Cloud Peak Wilderness monitoring stations from 2003 through 2013. Both stations show similar visibility results with high visibility range above 50 kilometers for the majority of the 10-year period.

3.1.5 Deposition

Deposition occurs when acid-forming particles in the atmosphere such as nitrate ion (NO_3^-), sulfate ion (SO_4^{2-}) and ammonium ion (NH_4^-) fall to the Earth's land and water (USEPA 2010). These acid-forming particles are the result of nitrogen oxides and sulfur oxides breaking down or chemically reacting with other compounds in the atmosphere (USEPA 2010). Deposition can occur in three forms: wet deposition where the particles fall by rain or snow, occult deposition where particles are transferred by clouds or fog, and dry deposition where particles either chemically react or physically fall to the Earth's surface (USEPA 2010).

The National Atmospheric Deposition Program (NADP) has monitoring stations across the United States to take real-time wet deposition readings (NADP 2014). Their National Trends Network (NTN) collects precipitation at a variety of locations away from pollution sources and analyzes the volume of liquid for concentrations of acid-forming ions such as NO_3^-, SO_4^{2-}, and NH_4^-. The nearest monitoring stations to the Project Area are Newcastle in Weston, WY and Wind Cave National Park - Elk Mountain in Custer, South Dakota. Both monitors are within 100 miles of the Project Area, with Newcastle's monitor being the closest at a distance of approximately 65 miles (NADP 2015). Based on data collected from 2005 through 2014, the annual average concentrations of nitrate ion and sulfate ion have decreasing trend lines, with higher concentrations recorded at Wind Cave National Park. The trend line for ammonium ion over the same period is increasing for Newcastle at a gradual rate whereas the concentration at Wind Cave National Park has been fairly steady for the past 10 years.

For dry deposition, the Clear Air Status and Trends Network (CASTNET) logs flux data from monitoring stations across the country (USEPA 2015b). Flux is the rate at which dry particles fall to the Earth over a certain area. In terms of dry deposition, flux is recorded in kilograms per hectare per hour. These fluxes are averaged over a week to then calculate an annual average. The nearest four (4) monitoring stations to the Project Area are at Newcastle, Wind Cave National Park, Buffalo in Johnson County, and Fortification Creek in Campbell County (USEPA 2015b). The only station that has recorded fluxes has been Wind Cave National Park starting in 2007. For all three ion fluxes, a downward trend has been recorded for the annual average up until 2014.

3.1.6 Sensitive Lakes and Lake Chemistry

The deposition of NO_3^-, SO_4^{2-}, and NH_4^- into bodies of water is a naturally occurring transfer of chemical components. The ability of a body of water to process and dilute the acid-causing deposition is known as its acid neutralizing capacity (ANC) which is dictated by its acidic saturation levels, biological activity, and the physical mixing of the surface water (Mast and Ingersoll 2011). According to the U.S. Forest Service, lakes in the Rocky Mountain region with an ANC level less than 50 microequivalents per liter (µeq/L) are considered sensitive to acidification (USFS et al. 2010). Furthermore, statistics have shown that lakes above 9,000 feet in elevation are likely more sensitive to acidification than those at lower elevations (USGS 2005, WWRC 1984).

With the trends of increasing deposition of nitrates and sulfates, the saturation of these ions in many higher elevation lakes is causing low ANC values. Also, the granite geology of the Bighorn National Forest, which is about 75 miles northwest of the Project Area, gives the lakes near and within the forest a lower ability to buffer excess deposition (Mast and Ingersoll 2011). For these reasons, the Bighorn National Forest has

lakes that are potentially sensitive to acidity from wet deposition. The USFS studied 64 lakes throughout the Rocky Mountain States from 1993 through 2009 to determine trends with different ion deposition as well as ANC values. Florence Lake and Emerald Lake in the Cloud Peak Wilderness Area are Big Horn mountain lakes that were included in this study. The average value from 1993 to 2009 was approximately 50 µeq/L for Florence Lake and 80 µeq/L for Emerald Lake. No significant positive or negative trend was shown in ANC values across the 17 year period (Mast and Ingersoll 2011).

3.1.7 Greenhouse Gas Emissions

The entrapment of heat in the lower atmosphere, also known as the greenhouse effect, raises the average surface temperature of the Earth through the absorption of reflected infrared radiation (IPCC 2013). Some greenhouse gases (GHGs), such as water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) occur naturally and from anthropogenic activities (i.e., resulting from or produced directly by human activities). Other GHGs, such as hydrofluorocarbons, result only from anthropogenic activities.

Greenhouse gases are chemically stable and persist in the atmosphere. They can also become well mixed throughout the atmosphere before being removed by physical or chemical processes. These GHGs have varying residence times in the atmosphere, but generally take years to fully breakdown. Furthermore, GHGs have varying potencies based on their ability to trap radiative energy (i.e., heat). The potency of different GHGs is determined by their potency relative to CO_2 and is referred to as a global warming potential (GWP). Based on the GWPs published by the Federal Register, it is determined that methane (CH_4) is 25 times more potent and N_2O is 298 times more potent than carbon dioxide (The Federal Register 2014).

The PRB which is central to the Project Area is a subsection of the Northwestern Great Plains. In 2011, the BLM published the Rapid Ecoregional Assessment for the Northwestern Plains to examine current environmental concerns and propose strategies for adapting to future climatic changes (BLM 2011b). Appendix C of that report specifically discusses climate change and presents models of future precipitation and temperature. For the PRB, an overall drier and stable temperature climate is expected by mid-century compared to the 20 year period before the 21st century. A seasonal analysis was conducted showing a slight increase in winter temperature with little to no changes in winter precipitation. However, in the summer, the PRB is predicted to experience the largest temperature increase in the ecoregion of 3.1 to 4.2 degrees Celsius joined with reduced precipitation levels. This combination can adversely affect evapotranspiration resulting in stressed vegetation lowering their resiliency against fires and beetle kill.

Currently, Converse County, WY generates GHGs from the combustion of fossil fuels (e.g., vehicles and electricity generation), oil and gas development, minerals mining, vegetation fires, livestock grazing, and farming.

3.1.8 Regulatory Implications and Background

The WDEQ Air Quality Division (AQD) has the regulatory authority to enforce state and federal environmental laws, including the federal Clean Air Act (CAA) and the permitting of air emission sources. The WDEQ-AQD regulates emissions from oil and gas sources through their Oil and Gas Permitting Guidance (WS Title 30, Ch. 5). The WDEQ typically does not permit mobile and temporary sources such as drill rigs.

3.1.8.1 National Ambient Air Quality Standards

Ambient air quality in a given location may be characterized by comparing the concentration of various pollutants in the ambient air with the standards set by federal and state agencies. Under the authority of the CAA, the USEPA has established nationwide air quality standards, known as the National Ambient Air Quality Standards (NAAQS). These standards represent the maximum allowable atmospheric concentration of the criteria pollutants. There are primary and secondary standards for these pollutants. The primary standards were established to protect public health with an adequate margin of safety, and the secondary standards were established to protect the public welfare from any known or anticipated adverse effects of a pollutant. Pollutants for which standards have been set include carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM) less than 10 or 2.5 microns in aerodynamic diameter (PM_{10} and $PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2), and lead. Individual states may adopt their own standards but they must be at least as stringent as the NAAQS. Wyoming Ambient Air Quality Standards (WAAQS) and NAAQS identify maximum limits for air pollutant concentrations at all locations to which the public has access. Wyoming has additional standards for hydrogen sulfide (H_2S). **Table 3.1.8.1-1** lists the current NAAQS and WAAQS and averaging times for each regulated pollutant.

Table 3.1.8.1-1.Ambient Air Quality Standards

Pollutant	Averaging Period(s)	NAAQS[1]	WAAQS[2]
CO	1-hour 8-hour	35 ppm (40,000 μg/m^3) [3] 9 ppm (10,000 μg/m^3) [3]	35 ppm (40,000 μg/m^3) [3] 9 ppm (10,000 μg/m^3) [3]
NO_2	1-hour Annual	100 ppb (188 μg/m^3) [4] 53 ppb (100 μg/m^3) [5]	100 ppb (188 μg/m^3) [4] 53 ppb (100 μg/m^3) [5]
PM_{10}	24-hour Annual	150 μg/m^3 [6] -----	150 μg/m^3 [6] 50 μg/m^3 [11]
$PM_{2.5}$	24-hour Annual	35 μg/m^3 [4] 12 μg/m^3 [7]	35 μg/m^3 [4] 15 μg/m^3 [6]
O_3	8-hour	75 ppb [8]	75 ppb [8]
SO_2	1-hour	75 ppb (196 μg/m^3) [9]	75 ppb (196 μg/m^3) [9]
Lead	Rolling 3 month	0.15 μg/m^3 [10]	0.15 μg/m^3 [10]
H_2S	30 minutes 30 minutes	----	70 μg/m3 [2, 11] 40 μg/m3 [2, 12]

[1] Source: 40 CFR Part 50
[2] Source: WDEQ-AQD 2014c Chapter 2, Ambient Standards
[3] Not to be exceeded more than once per year.
[4] 98th percentile averaged over three years.
[5] Annual mean.
[6] Not to be exceeded more than once per year on average over three years.
[7] Annual mean, averaged over three years.
[8] Annual fourth-highest daily maximum 8-hour ozone concentration averaged over three years.
[9] 99th percentile of 1-hour daily maximum concentrations, averaged over three years.
[10] Not to be exceeded.
[11] Average not to be exceeded more than two times per year.
[12] Average not to be exceeded more than two times in any five consecutive days.
[13] parts per billion (ppb)
[14] parts per million (ppm)

If the ambient air in a specified region meets the NAAQS, it is designated as an attainment area. Conversely, if a region does not meet the NAAQS, it is designated as a nonattainment area. Determinations for attainment and nonattainment are made by modeling air monitoring data. If an area does not have adequate

air monitoring data to make a determination, it is designated unclassified and treated as an attainment area. The PRB is designated as "attainment or unclassified" for all criteria pollutants.

3.1.8.2 New Source Performance Standards

New Source Performance Standards (NSPS) are pollution control standards developed by the USEPA under the authority of the CAA (40 CFR Part 60). NSPS apply to specific categories of new, modified, and reconstructed stationary sources and define emission limits for specified pollutants, compliance requirements, monitoring requirements, as well as test methods and procedures. NSPS that could potentially be applicable to the Project Area include:

- Subpart A: General Provisions
- Subpart K: Storage Vessels for Petroleum Liquids for Which Construction,
- Reconstruction, or Modification Commenced After June 11, 1973, and Prior to May 19, 1978
- Subpart Ka: Storage Vessels for Petroleum Liquids for Which Construction,
- Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984
- Subpart Kb: Storage Vessels for Petroleum Liquids for Which Construction,
- Reconstruction, or Modification Commenced After July 23, 1984
- Subpart IIII: Stationary Compression Ignition Internal Combustion Engines
- Subpart JJJJ: Stationary Spark Ignition Internal Combustion Engines
- Subpart OOOO: Crude Oil and Natural Gas Production, Transmission and Distribution

3.1.8.3 Hazardous Air Pollutants

Hazardous Air Pollutants (HAPs) are pollutants that are suspected of causing cancer or other serious health effects or can cause adverse environmental and ecological impacts. The USEPA has classified 188 air pollutants as HAPs under the amended CAA of 1990. Examples of listed HAPs associated with the oil and gas industry include benzene, toluene, ethylbenzene, xylene (BTEX compounds), formaldehyde, and normal-hexane (n-hexane). Although HAPs do not have federal ambient air quality standards, some states have established "significance thresholds" to evaluate human exposure to potential chronic inhalation illnesses and cancer risks. However, the State of Wyoming has not established any ambient air quality standards or significant thresholds for HAPs.

Since there are no applicable federal or State of Wyoming ambient air quality standards for HAPs, Reference Concentrations (RfC) for chronic inhalation exposure and Reference Exposure Levels (REL) for acute inhalation exposures are used to evaluate potential impacts of HAPs. RfCs represent an estimate of the continuous inhalation exposure rate to the human population without an appreciable risk of harmful effects. The REL is the acute concentration at or below which no adverse health effects are expected. Both the RfC and REL guideline values are for non-cancer effects.

Under Section 112 of the CAA, the USEPA is required to develop regulations establishing National Emission Standards for Hazardous Air Pollutants (NESHAPs) for all specific source categories. These standards are established to reflect the maximum degree of reduction in HAP emissions determined to be achievable through application of Maximum Achievable Control Technology (MACT). The potentially applicable MACT standards (40 CFR Part 63) for the Project Area include the following NESHAP:

- Subpart HH: Oil and Natural Gas Production Facilities
- Subpart ZZZZ: Stationary Reciprocating Internal Combustion Engines (RICE)

3.1.8.4 Greenhouse Gases Regulations

The CEQ released revised draft guidance in 2014 on how federal agencies should consider and evaluate GHG emissions and climate change under the NEPA. According to this draft guidance, if a proposed action is expected to cause direct emissions of 25,000 metric tons or more of carbon dioxide-equivalent GHG emissions on an annual basis, a quantitative and qualitative assessment should be considered together with mitigation measures and reasonable alternatives to reduce GHG emissions (CEQ 2014).

The WDEQ does not regulate greenhouse gas emissions for oil and gas production sources. For upstream operations, such as those in Project Area, quantifying greenhouse gas emissions is voluntary when applying for minor source air permits. Furthermore, triennial minor source inventories, as would be required for PRB operations, do not require quantification of GHGs.

The USEPA published Mandatory Reporting of Greenhouse Gases (40 CFR Part 98) in October 2009. This rule requires mandatory reporting of GHG emissions for 41 source categories that generally emit more than 25,000 metric tons of carbon dioxide-equivalent GHG emissions on an annual basis. This rule does not provide any emission limits for GHGs. Additionally, Subpart W of 40 CFR Part 98 was issued in November 2010. This subpart specifically addresses reporting of GHGs from Petroleum and Natural Gas Systems. Equipment associated with oil and gas development is also subject to Subpart C of 40 CFR Part 98, which regulates reporting of General Stationary Fuel Combustion Sources.

3.1.9 Existing Air Quality

According to the WOGCC database, as of November 3, 2015, there are 103 existing and permitted wells in the Project Area. These include approximately 94 oil wells, 8 natural gas wells, and 1 coal bed natural gas (CBNG) wells. Of these, there are 32 producing horizontal oil wells and 5 producing horizontal natural gas wells. Sixty horizontal oil wells and 2 horizontal natural gas wells have APDs, but have not yet been drilled. Remaining wells in the Project Area are inactive or not-producing (e.g., shut-in, temporarily abandoned, permanently abandoned), or their status is unknown.

From those oil and gas operations, existing point and area sources of air pollution within the PRB include the following:

- Exhaust emissions of mainly CO, oxides of nitrogen (NO_x), and diesel exhaust particulate from drill rig engines associated with oil and gas exploration and development.
- Fugitive dust (PM_{10} and $PM_{2.5}$) and other emissions associated with construction of oil and gas well sites.
- Emissions of CO, NO_x, volatile organic compounds (VOC), PM_{10}, and $PM_{2.5}$ from equipment located at producing oil and gas well heads (e.g., heaters, separators, tanks, pumpjack engines, etc.).
- Exhaust emissions (primarily CO, NO_x, and formaldehyde) from natural gas fired compressor engines used in production of natural gas.
- Natural gas dehydrator still-vent emissions of VOCs and HAPs, including BTEX and n-hexane.

- Gasoline and diesel-fueled vehicle tailpipe emissions of VOCs, NO_x, CO, SO_2, PM_{10} or $PM_{2.5}$.
- Fugitive dust (in the form of PM_{10} and $PM_{2.5}$) from vehicle traffic on unpaved and paved roads, wind erosion in areas of soil disturbance, and road sanding during winter months.

There are also other existing sources of air pollution near the Project Area, including mining activity, and CBNG well drilling and operation, amongst others such as power plants and residential wood burning.

3.1.10 Existing Air Pollutant Monitoring Data

The PRB is designated as attainment/unclassified for all criteria pollutants. Site-specific air quality monitoring data from multiple monitor locations are available for the Project Area. Since the prevailing winds are from the northwest, monitors to the northwest of the Project Area are ideal. The WDEQ operates monitors as part of the State and Local Monitoring Site (SLAMS) network and the Special Purpose Monitoring (SPM) network amongst other monitors. These background values are used in dispersion models by adding them to project specific air quality impacts so that an evaluation can be made on whether the source will meet NAAQS. The background values presented in **Table 3.1.10-1** are not equivalent to an USEPA determination for non-compliance or non-attainment of the NAAQS, but rather an analysis of monitoring data to represent the Project Area. **Table 3.1.10-1** lists the latest ambient air quality background values for those criteria pollutants and provides averaging times from which WAAQS and NAAQS have been established. Lead is not included in the table because lead emissions are commonly in very minor quantities from oil and gas sources.

The mining industry operates an extensive network of monitors due to the density of coal mines in the region. Coal mines produce large amounts of particulate matter and any monitoring stations within the boundary of a mining operation would not be representative of regional baseline air quality. Therefore, monitoring stations heavily affected by coal mines and other industrial monitors were excluded due to being unrepresentative of the project area ambient concentrations. Additionally, only Federal Equivalent Method (FEM) and Federal Reference Method (FRM) monitors were considered as data from those monitors following federal monitoring methods and quality control. The Sheridan monitoring station is not representative of concentrations in the Project Area because the monitor is in a PM_{10} non-attainment area, and the residential monitor location is influenced by residential wood burning in the winter. A Converse County Mobile monitoring station is located southeast of the Project Area and collects NO_2, O_3, PM_{10} and $PM_{2.5}$; however, it has only been in operation since 2012. Concentrations of background ambient air quality are taken from Cheyenne NCore, Thunder Basin, and Casper monitoring stations. Although the Cheyenne NCore monitoring station is located in Cheyenne, WY and farther from the Project Area, it is considered to be an acceptable monitor for CO and SO_2. Thunder Basin monitoring station is a general purpose monitor located to the north of the Project Area, and NO_2 and O_3 data are available starting from 2001. Casper monitoring station is ideal for PM_{10} and $PM_{2.5}$ since monitoring data for both pollutants are from the same location. The monitoring stations utilized in this EA for baseline air quality metrics were vetted by the WDEQ, AQD.

Table 3.1.10-1. Pre-Project Background Ambient Air Quality in the PRB

Criteria Pollutant	Averaging Period(s)	PRB Background Concentration	WAAQS[2]	NAAQS[2]
CO [c]	1-hour 8-hour	0.7 ppm (800 μg/m^3) 0.3 ppm (343 μg/m^3)	35 ppm (40,000 μg/m^3) 9 ppm (10,000 μg/m^3)	35 ppm (40,000 μg/m^3) 9 ppm (10,000 μg/m^3)
NO_2 [4]	1-hour Annual	10.3 ppb (19.4 μg/m^3) 4.4 ppb (8.2 μg/m^3)	100 ppb (188 μg/m^3) 53 ppb (100 μg/m^3)	100 ppb (188 μg/m^3) 53 ppb (100 μg/m^3)
O_3 [5]	8-hour	0.064 ppm (126 μg/m^3)	0.075 ppm (147 μg/m^3)	0.075 ppm (147 μg/m^3)
PM_{10} [6]	24-hour Annual	46.7 μg/m^3 ---	150 μg/m^3 50 μg/m^3	150 μg/m^3 ---
$PM_{2.5}$ [7]	24-hour Annual	14.3 μg/m^3 5.4 μg/m^3	35 μg/m^3 12 μg/m^3	35 μg/m^3 12 μg/m^3
SO_2 [5]	1-hour 3-hour	5.7 ppb (14.8 μg/m^3) 0.0072 ppm (18.8 μg/m^3)	75 ppb (196 μg/m^3) 0.5 ppm (1,300 μg/m^3)	75 ppb (196 μg/m^3) 0.5 ppm (1,300 μg/m^3)

[1] See discussions in **Section 3.1.10** for how the background values were established.
[2] See **Table 3.1.8.1-1**, which defines the WAAQS and NAAQS.
[3] Monitoring data from Cheyenne NCore Monitoring Station, Wyoming: 1-hour maximum value is for 2012 and 8-hour maximum value is for both 2012 and 2013.
[4] Monitoring data from Thunder Basin Monitoring Station, Wyoming: 1-hour concentration is the three year average (2011-2013) of daily maximum 98th percentile 1-hour concentrations, annual maximum value is for 2012.
[5] Monitoring data from Thunder Basin Monitoring Station, Wyoming: 8-hour concentration is the three year average (2011-2013) of high-4th-high concentrations.
[6] Monitoring data from Casper Monitoring Station, Wyoming: 24-hour concentration is the three year average (2011-2013) of high-2nd-high concentrations.
[7] Monitoring data from Casper Monitoring Station, Wyoming: 24-hour value is the three year average (2011-2013) of daily maximum 98th percentile 24-hour concentrations, annual value is three year average (2011-2013) of annual means.
[8] Monitoring data from Cheyenne N Core, Wyoming: 1-hour value is the three year average (2011-2013) of daily maximum 98th percentile 1-hour concentrations, 3-hour maximum value is for 2011 and 2013.

Please also note, the background values presented below have been reviewed and approved by WDEQ-AQD in April 2014 (personal communication WDEQ-AQD 2014b).

3.2 GEOLOGIC RESOURCES

The Project Area is located within the PRB physiographic province of Wyoming (WSGS 2014a). The PRB is characteristic of a wide, moderately deep, asymmetrical basin that is bounded by the Black Hills in the east; Casper Arch, Laramie Range, and Hartville Uplift in the south; and the Big Horn Mountains in the west. The elevation within the Project Area ranges from 4,500 feet amsl to 5,500 feet amsl. Geomorphologically, the PRB is characterized by prairie, low sandstone escarpments, and small canyons and valleys formed by intermittent surface streams (Lane et al. 1972). Exposed rock within the interior of the PRB generally consists of lower Tertiary rocks including the Paleocene Fort Union Formation and the Eocene Wasatch Formation, which can reach up to 4,000 feet in thickness along the basin axis. Rocks exposed at the upturned edges of the PRB are defined by Cretaceous marine sedimentary rock (BLM 2009).

3.2.1 General Stratigraphy

Rocks exposed at the surface within the Project Area were formed during the Cenozoic era and Quaternary and Tertiary systems (Gregory and Micale 2007). Bedrock outcrop mapping by the Wyoming State

Geological Survey (WSGS) has identified two tertiary rock exposures the Project Area, including the Fort Union Formation, which contains the Tongue River and Lebo Shale Members (undivided, map unit Tftl), and the Wasatch Formation (map unit Tw). The Wasatch and Fort Union formations are separated by an unconformity. Additionally, two quaternary deposits, alluvial (Qa) and baked and fused rock (Qb), are present within the Project Area. The distribution of bedrock formations mapped by the WSGS is presented in **Figure 3.2.1-1** and descriptions of each map unit present can be found below in **Table 3.2.1-1** below.

Deeper rock formations within the Project Area that contain hydrocarbons and are targeted by the proposed project include the Turner Sandy Member and Parkman Sandstone Member. EOG may also target other formations such as the Mowry, Niobrara, Shannon, and Sussex, depending on the information gathered during exploration. While not currently listed in the APDs as target formations, EOG may add these as target formations to certain wells via Sundry.

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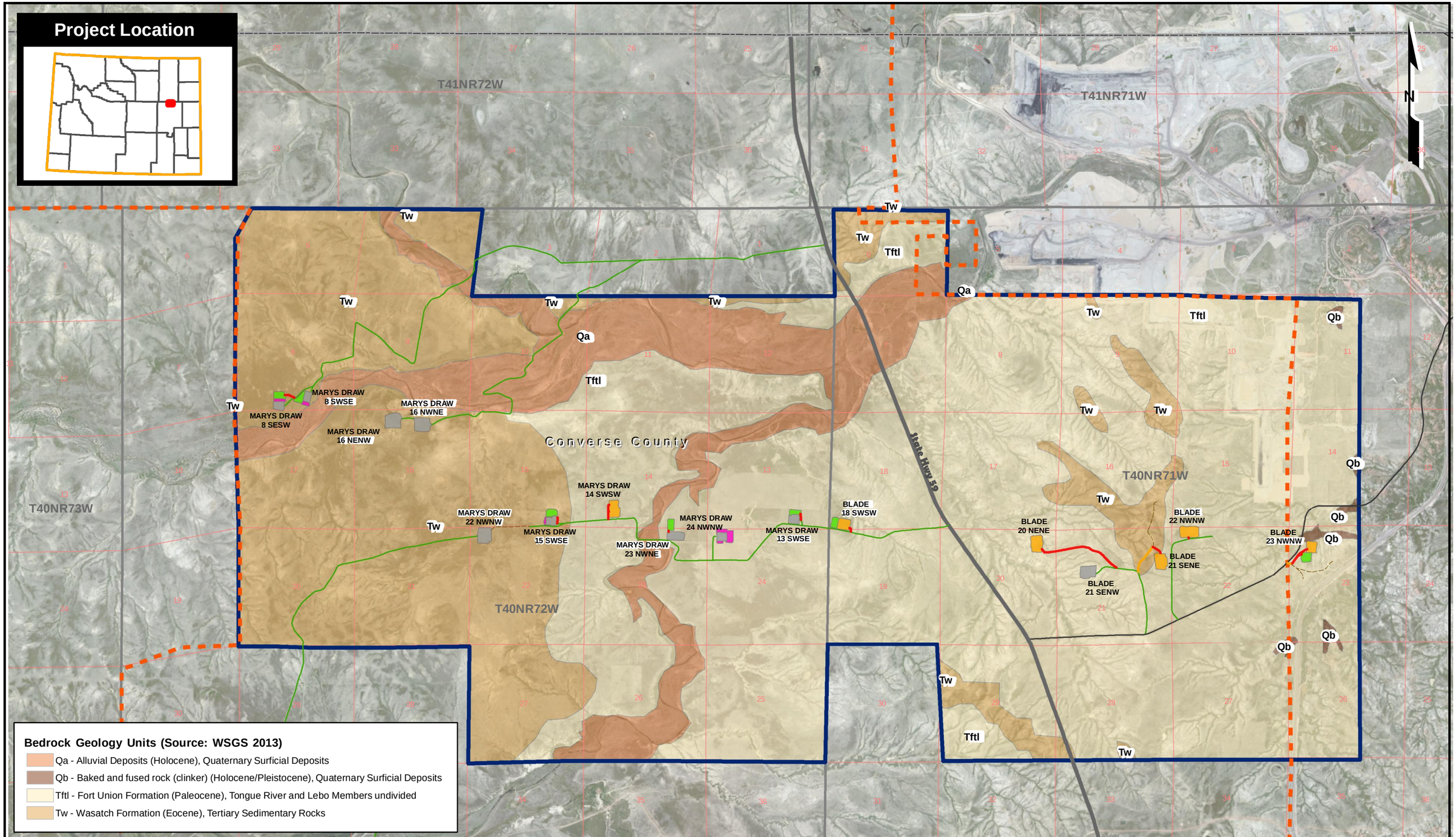

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Legend

- Proposed Well Pad
- Proposed Facilities Pad
- Proposed Pad Expansion
- Existing Well Pad
- Proposed Access Road
- Proposed Road Upgrade
- Highway
- County Road
- Existing Access Road
- Existing Two-track
- Greater Crossbow EIS Project Area
- County Boundary
- Township/Range Boundary
- Section Boundary

Project Area Boundary: EOG (2015)

- 2015 Interim EA Project Area

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PROJECT NO.	20154640.001A
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CHECKED BY:	M. Bridendall
FILE NAME:	3.2.1-1_BedrockGeology.mxd

Crossbow 2016 Interim Drilling EA
Bedrock Geology

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.2.1-1

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Table 3.2.1-1. Bedrock Geology of the Project Area

Map Unit Symbol	Unit	Acres In Project Area	Percent Of Project Area	Series/Epoch	
Tftl	Fort Union Formation Tongue River and Lebo Shale Members	14,508.7	59.7	Paleocene	**The Tongue River Member** – A light to dark gray fine-grained sandstone that is interbedded with drab siltstone, claystone, and shale. Thick coal beds, which can exceed150 feet in thickness, are found near the top of the member. These sedimentary rocks were derived from sediment deposits within stream, swamp, or lacustrine environments.
					Lebo Member – interbedded gray, very fine-grained sandstone, siltstone, claystone, carbonaceous shale, and coal. The sediments that formed these rocks were deposited in stream and marsh environments. Iron-rich calcareous concretions ranging from marble size to several feet in diameter are found can be found throughout the unit. The combined thickness of the Tongue River and Lebo members ranges from 1,370 to 3,280 feet.
Tw	Wasatch Formation	6,921.2	28.5	Eocene	A gray to buff claystone and siltstone with a medium- to coarse-grained crossbedded arkosic sandstone. Thin beds of carbonaceous shale and coal occur locally. The sediments that formed these rocks were deposited in stream and marsh environments. Unit thickness can range from 1,575 to 2,250 feet.
Qb	Baked and Fused Rock (Clinker)	78.5	0.3	Holocene/Pleistocene	Composed of hard, dense, red to orange baked shale and siltstone, and may be bubbly or glassy. These rocks formed as overlying strata was altered by burning coal beds in the Wasatch and Fort Union Formations. Talus forms locally where blocks have detached from scarps of baked and fused rock and have moved down slope. Unit thickness ranges from 3 to 33 feet.
Qa	Alluvial Deposits	2,776.3	11.4	Holocene	Unconsolidated channel fill, flood plain, and low terraces consisting of reworked sediments including sandstone, ironstone, and fossil wood derived from the White River Formation. The thickness of this unit ranges from 5 to 25 feet.
Total		**24,284.7**	**100.0**		

Source: Gregory and Micale 2007

3.2.2 Geologic Hazards

The primary geologic hazards within the BLM CFO planning area include earthquakes, landslides (mass wasting), and surface topography hazards. Other potential hazards within the BLM CFO planning area include flood-prone areas, radon, shrinking-swelling clay, selenium, windblown areas, and mine subsidence areas. No known occurrences of these hazards are present within the Project Area.

The United States Geological Survey (USGS) and WSGS monitor earthquake events within Wyoming. No fault lines occur within the Project Area and no earthquakes have been recorded within the Project Area. The BLM CFO has mapped areas with high and moderate landslide potentials, none of which occur within or near the Project Area.

The Converse County Rd 37 (136711) mine is located along the eastern border of the Project Area in Section 14 of T40N R71W. Products mined at this location are not known. General physical hazards associated with abandoned mine locations can include open vertical shafts, unstable overhead rock, decayed support structures, toxic gasses, reduced oxygen, explosives, and other toxic mining chemicals (BLM 2013a). Abandoned mine lands may also serve as a vector for the introduction of contaminants in to groundwater. The BLM addresses the abandoned mines under the Abandoned Mine Land Program, which identifies and remediates safety risks associated with these features (BLM 2007c).

Coal seam fires are also a geologic hazard within the PRB (BLM 2013a). These fires can originate from lightning strikes, wildfires, or spontaneous combustion, and can burn for decades. These events emit gases such as CO_2, carbon monoxide, and methane making them a threat to public health and safety. Coal seam fires can produce subsurface voids, leading to subsidence and surface fissures, which may in turn ignite wildfires. No known, active coal seam fires are present within the Project Area.

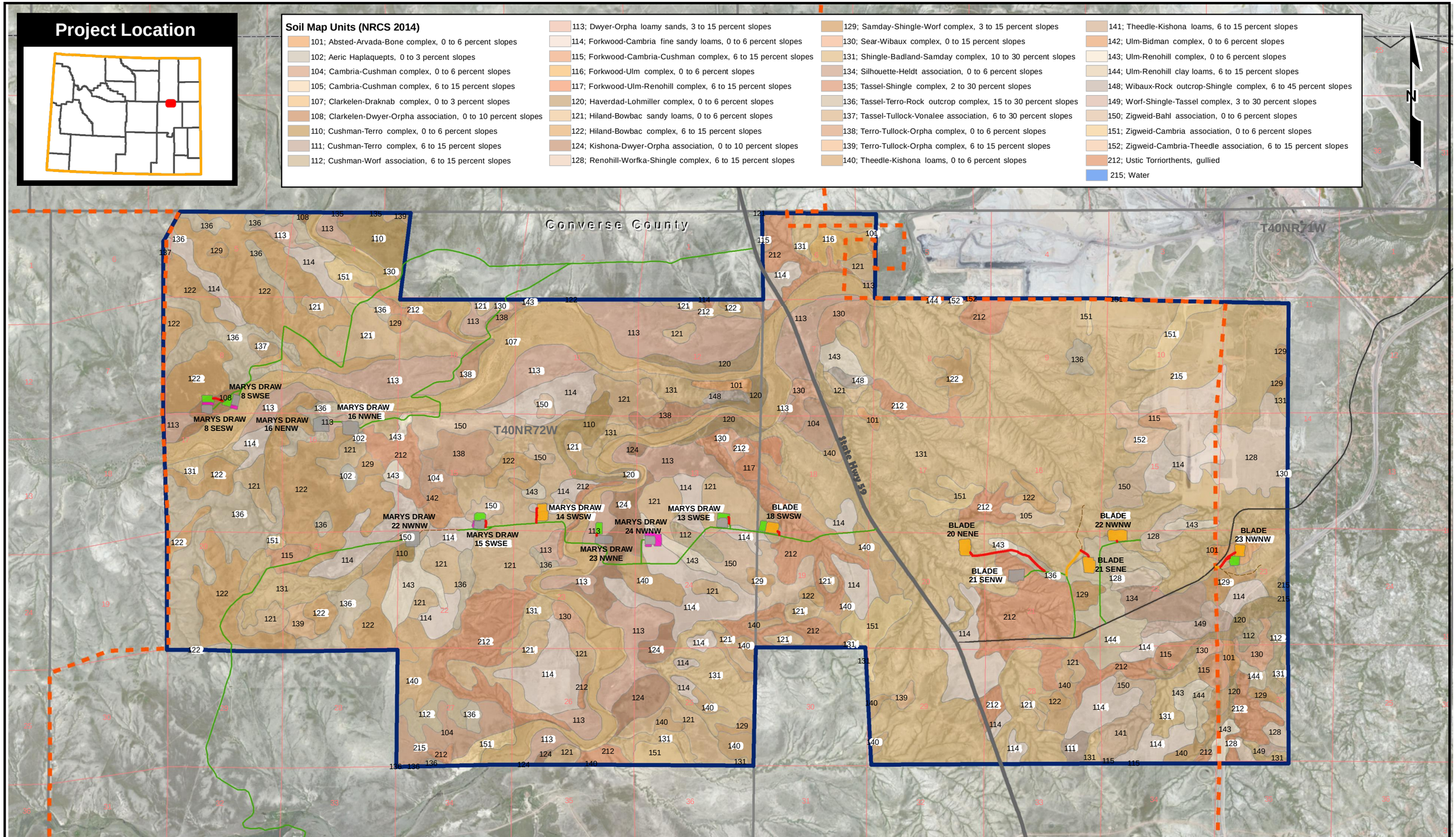
3.3 SOILS

Detailed soil surveys and mapping were conducted within the Project Area by the United States Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS) as a part of the Soil Survey of Converse County, Wyoming, Northern Part (USDA-NRCS 1988). For the purpose of providing the most accurate data, the soil survey is supplemented by the NRCS's Web Soil Survey; therefore the Web Soil Survey is the primary source of information regarding soils within the Project Area (USDA-NRCS 2014).

3.3.1 Soil Classifications

A total of 40 soil map units are mapped within the Project Area and are shown in **Figure 3.3.1-1** and listed in **Table 3.3.1-1**. Each detailed soil map unit consists of one or more general soil series that occur in association with each other. The map units cover areas from 4.6 acres to 6,197.7 acres in size within the Project Area.

Soils within the Project Area are developed from alluvium, residuum, eolian sands, and colluvium parent material. Soil textures within the Project Area include sandy loam, clay loam, sandy clay loam, channery loam, loam, fine sandy loam, loamy sand, and variations of these types. Representative slopes range from 2 to 26 percent. The soil map units within the Project Area are predominately classified as well drained with some soil maps units classified as poorly drained, somewhat excessively drained, and excessively drained (USDA-NRCS 2014).


Project Location
Soil Map Units (NRCS 2014)
101; Absted-Arvada-Bone complex, 0 to 6 percent slopes
102; Aeric Haplaquepts, 0 to 3 percent slopes
104; Cambria-Cushman complex, 0 to 6 percent slopes
105; Cambria-Cushman complex, 6 to 15 percent slopes
107; Clarkelen-Draknab complex, 0 to 3 percent slopes
108; Clarkelen-Dwyer-Orpha association, 0 to 10 percent slopes
110; Cushman-Terro complex, 0 to 6 percent slopes
111; Cushman-Terro complex, 6 to 15 percent slopes
112; Cushman-Worf association, 6 to 15 percent slopes
113; Dwyer-Orpha loamy sands, 3 to 15 percent slopes
114; Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes
115; Forkwood-Cambria-Cushman complex, 6 to 15 percent slopes
116; Forkwood-Ulm complex, 0 to 6 percent slopes
117; Forkwood-Ulm-Renohill complex, 6 to 15 percent slopes
120; Haverdad-Lohmiller complex, 0 to 6 percent slopes
121; Hiland-Bowbac sandy loams, 0 to 6 percent slopes
122; Hiland-Bowbac complex, 6 to 15 percent slopes
124; Kishona-Dwyer-Orpha association, 0 to 10 percent slopes
128; Renohill-Worfka-Shingle complex, 6 to 15 percent slopes
129; Samday-Shingle-Worf complex, 3 to 15 percent slopes
130; Sear-Wibaux complex, 0 to 15 percent slopes
131; Shingle-Badland-Samday complex, 10 to 30 percent slopes
134; Silhouette-Heldt association, 0 to 6 percent slopes
135; Tassel-Shingle complex, 2 to 30 percent slopes
136; Tassel-Terro-Rock outcrop complex, 15 to 30 percent slopes
137; Tassel-Tullock-Vonalee association, 6 to 30 percent slopes
138; Terro-Tullock-Orpha complex, 0 to 6 percent slopes
139; Terro-Tullock-Orpha complex, 6 to 15 percent slopes
140; Theedle-Kishona loams, 0 to 6 percent slopes
141; Theedle-Kishona loams, 6 to 15 percent slopes
142; Ulm-Bidman complex, 0 to 6 percent slopes
143; Ulm-Renohill complex, 0 to 6 percent slopes
144; Ulm-Renohill clay loams, 6 to 15 percent slopes
148; Wibaux-Rock outcrop-Shingle complex, 6 to 45 percent slopes
149; Worf-Shingle-Tassel complex, 3 to 30 percent slopes
150; Zigweid-Bahl association, 0 to 6 percent slopes
151; Zigweid-Cambria association, 0 to 6 percent slopes
152; Zigweid-Cambria-Theedle association, 6 to 15 percent slopes
212; Ustic Torriorthents, gullied
215; Water
N
Converse County
T40NR71W
T40NR72W
State Hwy 59
MARYS DRAW 8 SWSE
MARYS DRAW 8 SESW
MARYS DRAW 16 NENW
MARYS DRAW 16 NWNE
MARYS DRAW 22 NWNW
MARYS DRAW 15 SWSE
MARYS DRAW 14 SWSW
MARYS DRAW 24 NWNW
MARYS DRAW 13 SWSE
MARYS DRAW 23 NWNE
BLADE 18 SWSW
BLADE 20 NENE
BLADE 21 SENW
BLADE 22 NWNW
BLADE 21 SENE
BLADE 23 NWNW
0 0.25 0.5 1 Miles
Legend
Proposed Well Pad
Proposed Facilities Pad
Proposed Pad Expansion
Existing Well Pad
Proposed Access Road
Proposed Road Upgrade
Highway
County Road
Existing Access Road
Existing Two-track
Greater Crossbow EIS Project Area
County Boundary
Township/Range Boundary
Section Boundary
Project Area Boundary: EOG (2015)
2015 Interim EA Project Area
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CHECKED BY: M. Bridendall
FILE NAME: 3.3.1-1_SoilMapUnits.mxd
Crossbow 2016 Interim Drilling EA
Soil Map Units
EOG Resources, Inc.
Converse County, Wyoming
FIGURE
3.3.1-1

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Table 3.3.1-1. Soil Map Units within the Project Area

Map Unit Symbol	Map Unit Name	Acres in Project Area[1]	Percent of Project Area	K_w-Factor	Wind Erodability Index	Erosion Hazard	Restoration Potential
101	Absted-Arvada-Bone complex, 0 to 6 percent slopes	111.2	0.46	0.37	48	Slight	Low
102	Aeric Haplaquepts, 0 to 3 percent slopes	19.7	0.08	0.28	48	Slight	High
104	Cambria-Cushman complex, 0 to 6 percent slopes	280.6	1.16	0.28	86	Slight	High
105	Cambria-Cushman complex, 6 to 15 percent slopes	58.8	0.24	0.28	86	Slight	High
107	Clarkelen-Draknab complex, 0 to 3 percent slopes	1,526.9	6.29	0.37	86	Slight	High
108	Clarkelen-Dwyer-Orpha association, 0 to 10 percent slopes	59.5	0.25	0.32	134	Slight	High
110	Cushman-Terro complex, 0 to 6 percent slopes	231.2	0.95	0.37	56	Slight	High
111	Cushman-Terro complex, 6 to 15 percent slopes	30.6	0.13	0.43	56	Moderate	High
112	Cushman-Worf association, 6 to 15 percent slopes	208.2	0.86	0.43	56	Slight	High
113	Dwyer-Orpha loamy sands, 3 to 15 percent slopes	1,538.8	6.34	0.15	134	Slight	High
114	Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes	153.1	0.63	0.28	86	Slight	High
115	Forkwood-Cambria-Cushman complex, 6 to 15 percent slopes	1,931.8	7.95	0.28	86	Slight	High
116	Forkwood-Ulm complex, 0 to 6 percent slopes	64.5	0.27	0.28	86	Slight	High
117	Forkwood-Ulm-Renohill complex, 6 to 15 percent slopes	76.0	0.31	0.28	48	Slight	High
120	Haverdad-Lohmiller complex, 0 to 6 percent slopes	282.7	1.16	0.28	86	Slight	High
121	Hiland-Bowbac sandy loams, 0 to 6 percent slopes	2,046.9	8.43	0.24	86	Slight	High

Map Unit Symbol	Map Unit Name	Acres in Project Area[1]	Percent of Project Area	K_w-Factor	Wind Erodability Index	Erosion Hazard	Restoration Potential
122	Hiland-Bowbac complex, 6 to 15 percent	1,961.4	8.08	0.17	56	Slight	High
124	Kishona-Dwyer-Orpha association, 0 to 10 percent slopes	312.1	1.29	0.15	134	Slight	High
128	Renohill-Worfka-Shingle complex, 6 to 15 percent slopes	575.5	2.37	0.32	86	Slight	Moderate
129	Samday-Shingle-Worf complex, 3 to 15 percent slopes	215.5	0.89	0.43	86	Slight	Moderate
130	Sear-Wibaux complex, 0 to 15 percent slopes	253.6	1.04	0.32	48	Slight	High
131	Shingle-Badland-Samday complex, 10 to 30 percent slopes	6,197.7	25.52	0.37	86	Moderate	Moderate
134	Silhouette-Heldt association, 0 to 6 percent slopes	121.7	0.50	0.28	48	Slight	High
135	Tassel-Shingle complex, 2 to 30 percent slopes	8.4	0.03	0.43	86	Moderate	Moderate
136	Tassel-Terro-Rock outcrop complex, 15 to 30 percent slopes	1,114.1	4.59	0.28	134	Moderate	Moderate
137	Tassel-Tullock-Vonalee association, 6 to 30 percent slopes	25.3	0.10	0.24	134	Moderate	Moderate
138	Terro-Tullock-Orpha complex, 0 to 6 percent slopes	222.9	0.92	0.24	134	Slight	High
139	Terro-Tullock-Orpha complex, 6 to 15 percent slopes	60.6	0.25	0.15	134	Slight	High
140	Theedle-Kishona loams, 0 to 6 percent slopes	737.0	3.04	0.32	86	Slight	High
141	Theedle-Kishona loams, 6 to 15 percent slopes	85.2	0.35	0.32	86	Slight	High
142	Ulm-Bidman complex, 0 to 6 percent slopes	50.1	0.21	0.32	48	Slight	High
143	Ulm-Renohill complex, 0 to 6 percent slopes	321.9	1.33	0.37	48	Slight	High

Map Unit Symbol	Map Unit Name	Acres in Project Area[1]	Percent of Project Area	K_w-Factor	Wind Erodability Index	Erosion Hazard	Restoration Potential
144	Ulm-Renohill clay loams, 6 to 15 percent slopes	372.5	1.53	0.24	48	Slight	High
148	Wibaux-Rock outcrop-Shingle complex, 6 to 45 percent slopes	43.8	0.18	0.15	38	Moderate	Moderate
149	Worf-Shingle-Tassel complex, 3 to 30 percent slopes	86.4	0.36	0.28	86	Moderate	Moderate
150	Zigweid-Bahl association, 0 to 6 percent slopes	514.7	2.12	0.28	48	Slight	High
151	Zigweid-Cambria association, 0 to 6 percent slopes	71.9	0.30	0.32	48	Slight	High
152	Zigweid-Cambria-Theedle association, 6 to 15 percent slopes	418.6	1.72	0.32	86	Slight	High
212	Ustic Torriorthents, gullied	1,888.2	7.78	0.32	48	Moderate	High
215	Water	4.6	0.02	N/A	N/A	Not Rated	Not Rated
Total		**24,284.5**	**100.00**				

Source: USDA-NRCS 2014

[1] Total acreage estimates are based on GIS-software calculations and may not equal total acreage by soil map unit due to rounding, removal of overlapping development, and minute boundary discrepancies, GIS-based calculations are considered more accurate that estimates calculated using simple addition and, therefore, will be used throughout this document.

3.3.2 Soil Characteristics of Greatest Management Concern

For evaluation of potential environmental impacts to soils, several physical, chemical, and interpretive soil characteristics were evaluated within the Project Area. These soil characteristics include water erosion potential, wind erodibility, erosion hazard rating, and restoration potential.

3.3.2.1 Water Erosion Potential

Water erosion potential can vary widely among soil units within a given area and is dependent on the particle size distribution of the soil, the slopes on which it is found, the amount and type of vegetative cover, and the rate of runoff. The NRCS typically rates each of the soil units according to its whole soil water erosion potential (Kw). This erosion potential indicates the general susceptibility of a soil to sheet and rill erosion (USDA-NRCS 2014). Estimates of Kw are based primarily on percentage of silt, sand, organic matter, percentage of rock fragments, soil structure, and the saturated hydraulic conductivity of the soil. The value of Kw ranges from 0.02 to 0.69. The higher the Kw value of a soil type, the more susceptible that soil type is to water erosion. Erosion hazards become critical issues when protective vegetation is removed during the access road and well pad construction activities. Typically, soils found on steeper slopes

and unvegetated areas have a higher water erosion potential that those found on gentler slopes with vegetation present (USDA-NRCS 2014).

Approximately 1,200.0 acres (4.9 percent) of the soils in the Project Area have low water erosion potential ($Kw \leq 0.2$), and approximately 23,036.0 acres (94.9 percent) of the soils have a moderate erosion potential ($0.2 \leq Kw \leq 0.5$). No soils within the Project Area are considered to have high potential for erosions caused by surface water runoff.

3.3.2.2 Wind Erodibility

In addition to erosion by water, soils are also susceptible to erosion by wind. Wind erosion is closely correlated with the soil texture of the surface layer, the size and durability of surface clods, the proportion of rock fragments, and the presence of organic material. Soils with more fine particles are at greater risk of wind erosion, and soils with more gravel and/or stones have a lower risk of wind erosion. In addition, soil moisture and the presence of frozen soil layers also affect a soil's susceptibility to wind erosion. The NRCS estimates wind erodibility with an index of tons per acre per year that could be lost to wind erosion (USDA-NRCS 2014).

Approximately 3,113.2 acres (12.8 percent) of the soils in the Project Area have a low wind erodibility index (less than 50 tons per acre per year). Approximately 17,876.9 acres (73.6 percent) of the soils in the Project Area have a moderate wind erodibility index (between 50 and 100 tons per acre per year). The remaining 3,273.8 acres (13.5 percent) of the Project Area have a high wind erodibility index (greater than 100 tons per acre per year).

3.3.2.3 Erosion Hazard Rating

The erosion hazard rating indicates the hazard of soil loss from unsurfaced roads and trails. The rating is based on Kw, slope, and content of rock fragments. A rating of "slight" indicates that little or no erosion is likely; "moderate" indicates that some erosion is likely and roads may require occasional maintenance, and that simple erosion-control measures are needed; and "severe" indicates that significant erosion is expected, the roads require frequent maintenance, and that costly erosion-control measures are needed (USDS-NRCS 2014).

Soils within the Project Area have erosion hazard ratings ranging from slight to moderate, but most of the soils are rated as having a slight erosion hazard. Approximately 14,885.2 acres (61.3 percent) of the soils in the Project Area are rated as having a slight erosion hazard and approximately 9,394.7 acres (38.7 percent) are rated as a moderate erosion hazard.

3.3.2.4 Restoration Potential

Restoration potential rates a soil for its ability to recover from degradation by restoring functional and structural integrity after disturbance. This factor is dependent on the soil structure, adequate precipitation for recovery, soil salinity, soil depth, and sodium adsorption ratio. Excessive salinity (salt content) or sodicity (sodium content) can inhibit the growth of desirable vegetation, and therefore inhibit successful restoration.

The restoration potential of soils is described as high, moderate, or low. A rating of high indicates that the soil has soil properties that favor restoration. Moderate indicates that the soil has one or more properties that inhibit restoration. Low indicates that the soil has one or more properties that are very unfavorable to soil restoration. The overall rating class for each soil is assigned based on the product of the numerical ratings of the individual soil properties considered in the interpretation (USDA-NRCS 2014).

Approximately 15,971.0 acres (65.8 percent) of the soils in the Project Area are rated as having a high restoration potential. Approximately 8,197.7 acres (33.8 percent) of the soils in the Project Area are rated moderate for restoration potential, and 111.2 acres (0.5 percent) are rated as having a low restoration potential.

3.4 WATER RESOURCES, INCLUDING SURFACE AND GROUNDWATER QUALITY, HYDROLOGIC (STORMWATER) CONDITION, FLOODPLAINS, AND WATERS OF THE UNITED STATES

3.4.1 Regional Overview

The Project Area lies within the semi-arid plains of Wyoming within the Powder River structural basin and within the Cheyenne River drainage basin. Major tributaries of the Cheyenne River include Dry Fork Cheyenne River, Antelope Creek, Lightening Creek, Lance Creek, and Beaver Creek. The Cheyenne River in Wyoming flows east into South Dakota and flows in a northeasterly direction until its confluence with the Missouri River. Beaver Creek, a major tributary of the Cheyenne River, flows southeast until it meets Stockade Beaver Creek near the Wyoming-South Dakota state line. Shortly after, it flows into the Cheyenne River in South Dakota (HKM Engineering Inc. et al. 2002).

3.4.2 Surface Water

The main streams in the Project Area include Antelope Creek and two tributaries to Antelope Creek: Bates Creek and Sand Creek (**Figure 3.4.2-1**). Antelope Creek is a major tributary to the Cheyenne River, and flows in an easterly direction to combine with Dry Fork Cheyenne River outside the Project Area to create the Cheyenne River (USEPA 2013a). The entire Project Area is contained within the USGS Antelope hydrologic unit code (HUC) 10120101 and further sub-divided into the sub-units of Lower Bates Creek, Jenson Number 1 Reservoir – Antelope Creek, Lower Sand Creek, and Horse Creek – Antelope Creek. **Figure 3.4.2-2** depicts the subwatersheds within the Project Area and **Table 3.4.2-1** provides a summary of the area of each subwatershed.

Table 3.4.2-1. Subwatersheds within the Project Area

Watershed Name	HUC #	Subwatershed Name	Acres within Project Area	Percentage of Project Area
Antelope	101201010207	Lower Bates Creek	926.6	3.8
Antelope	101201010204	Jenson Number 1 Reservoir – Antelope Creek	6,785.2	27.9
Antelope	101201010104	Lower Sand Creek	6,478.8	26.7
Antelope	101201010301	Horse Creek – Antelope Creek	10,094.2	41.6
Total			**24,284.8**	**100.0**

Source: USEPA 2013a

The Project Area contains approximately 788,402.9 linear feet of USGS-mapped streams and canals or ditches. Intermittent streams represent the most abundant classification of USGS-mapped streams. No USGS-mapped ephemeral streams occur within the Project Area. **Table 3.4.2-2** provides a summary of USGS-mapped stream features within the Project Area.

Table 3.4.2-2. USGS-Mapped Stream Features within the Project Area

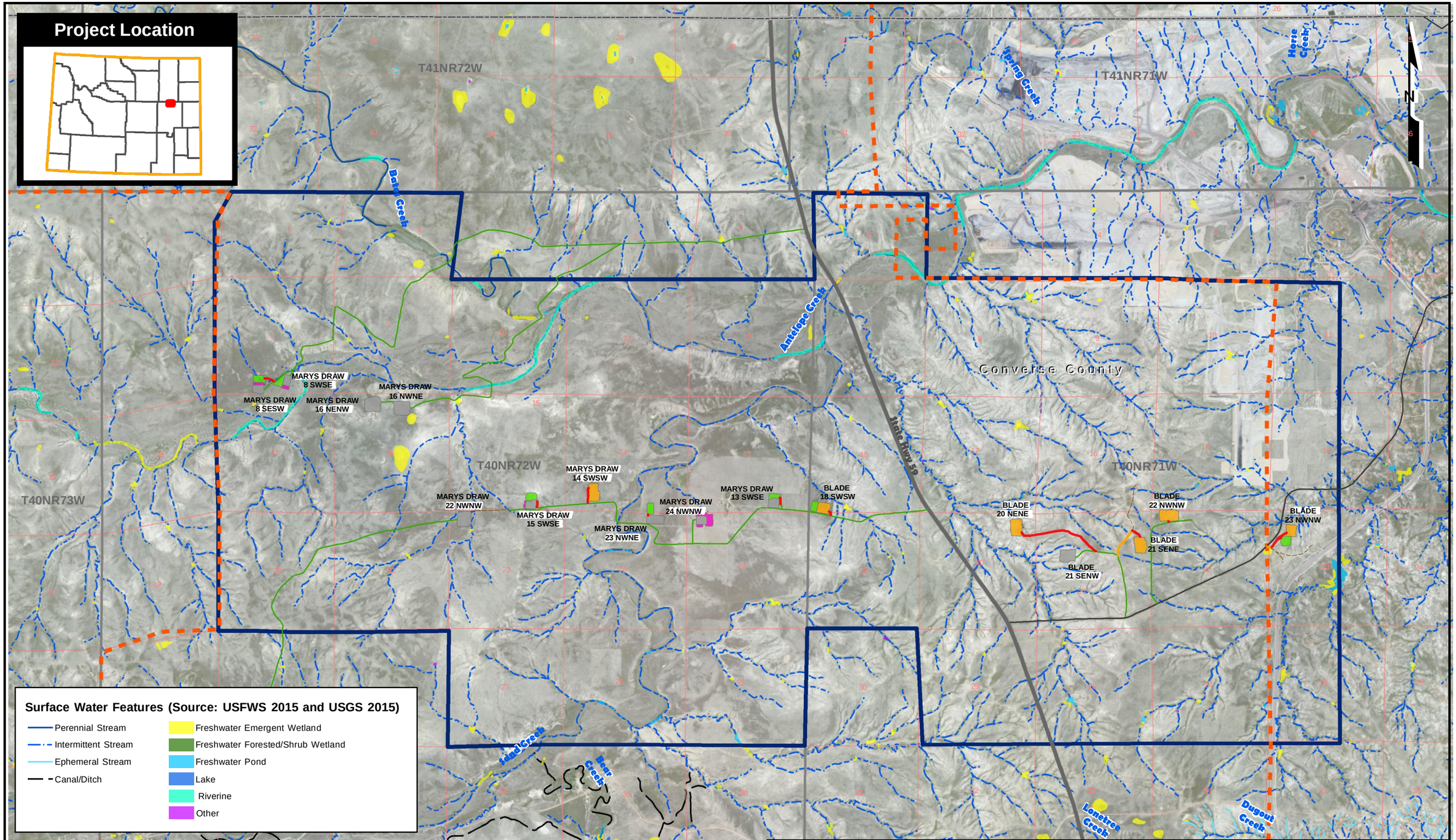
Stream Classification	Linear Feet within Project Area (feet)	Percentage within the Project Area
Ephemeral Streams	0.0	0.0
Intermittent Streams	757,874.2	96.1
Perennial Streams	7,121.8	0.9
Canals/Ditches	23,406.9	3.0
Total	**788,402.9**	**100.0**

Source: USGS 2006

3.4.2.1 Stream Classification

The WDEQ assigned Antelope Creek as a Class 3B stream. Class 3B waters are tributary waters, including adjacent wetlands, which are not known to support fish populations or drinking water supplies and where those uses are not attainable. Class 3B waters are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna, which inhabit waters of the state at some stage of their life cycles. Class 3B waters are characterized by frequent linear wetland occurrences or impoundments within or adjacent to the stream channel over its entire length. Such characteristics are a primary indicator used in identifying Class 3B waters (WDEQ 2013). WDEQ monitoring indicated that the benthic macro invertebrate community of Antelope Creek is comparable to reference conditions for intermittent streams in this basin and is supporting its aquatic life other than fish use.

Wyoming Game and Fish Department data show a diverse community of native non-game fish and warm water game fish, indicating that Antelope Creek should be classified as a Class 2ABww rather than 3B (WDEQ 2014). Class 2ABww waters support game fish populations or spawning and nursery areas, at least seasonally, and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is attainable. Class 2ABww waters include all permanent and seasonal “warm water” game fisheries. Unless confirmed otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2ABww waters are also protected for non-game fisheries, fish consumption, aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value uses.



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- County Boundary
- Township/Range Boundary
- Section Boundary
- Project Area Boundary: EOG (2015)
- 2015 Interim EA Project Area

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FILE NAME:	3.4.2-1_SurfaceWater.mxd

2015 Interim Drilling EA
Surface Water Features

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.4.2-1

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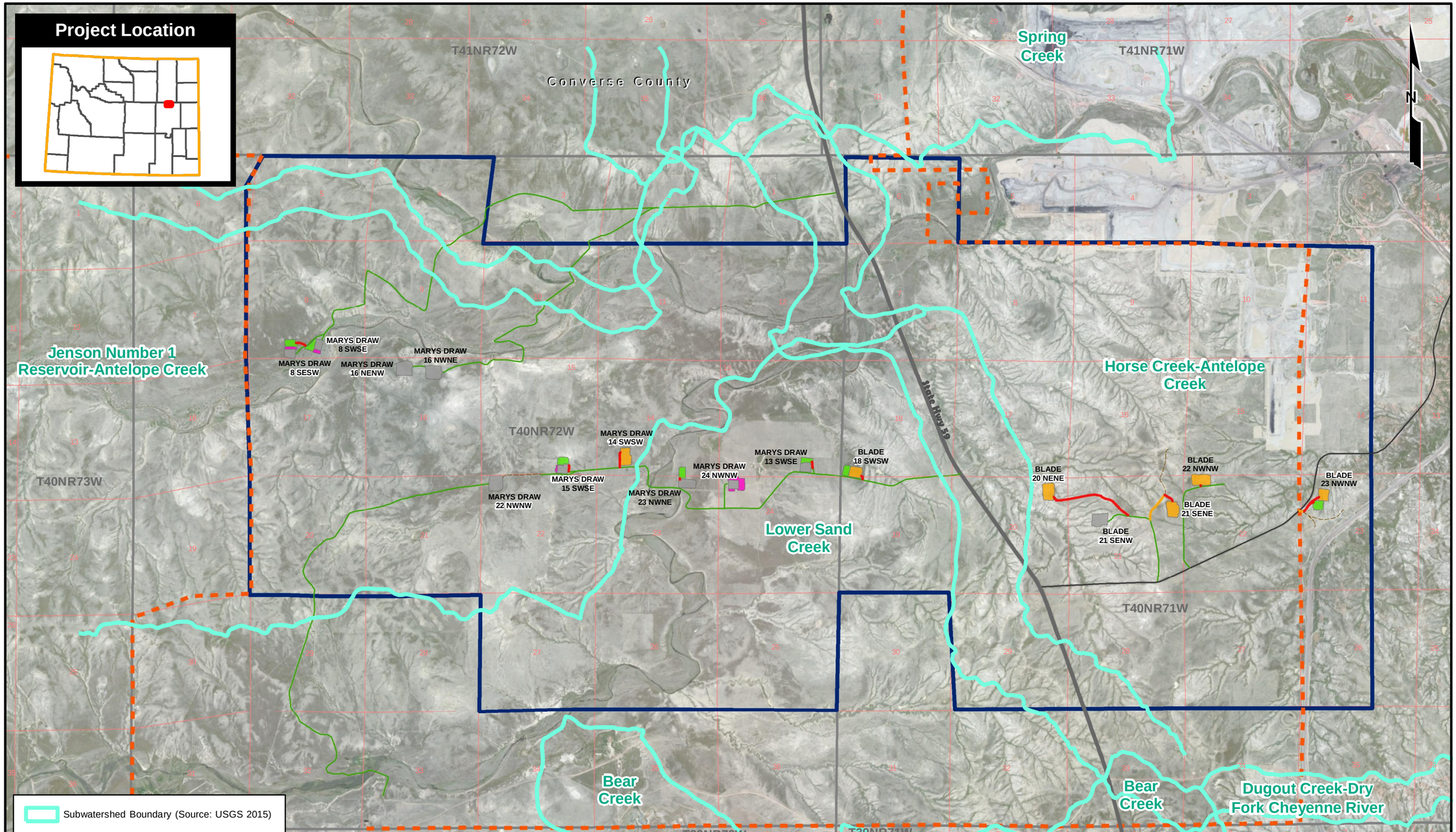

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Crossbow 2016 Interim Drilling EA
Subwatersheds

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.4.2-2

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3.4.2.2 Stream Flow

There are no USGS stream gauges within the Project Area. There is one USGS stream gauge (06364700) approximately 13.3 miles downstream of the Project Area after the confluence of Antelope Creek and Porcupine Creek, a major tributary to Antelope Creek. However, this gauge's period of record ended in 1981. Therefore the closest USGS stream gauge with a period of record extending beyond USGS stream gauge 06364700 is 06364300, which is located on Porcupine Creek approximately 10.7 miles upstream from the Antelope Creek confluence and approximately 24.0 miles from the Project Area.

3.4.2.3 Surface Water Quality

As of 2014, the WDEQ has assessed 6.4 percent of the 280,804 miles of Wyoming's ephemeral, intermittent, and perennial streams as a part of Wyoming's 2014 Integrated 305(b) and 303(d) Report. Antelope Creek was assessed from the confluence with the Cheyenne River to a point 85.6 miles upstream of the confluence. The entire segment of Antelope Creek within the Project Area has been assessed as a part of the report. The stream was found to be in good condition and is not listed as impaired (WDEQ 2014).

Water samples were taken, analyzed, and recorded at the USGS Antelope Creek near Teckla, WY Gauge (06364700) from October 1977 to February 2009 (USGS 2015a). Water quality criteria limits were obtained from the WDEQ (WDEQ 2013). **Table 3.4.2-4** compares the measured values to the state criteria.

Table 3.4.2-4. Surface Water Quality Associated with USGS Antelope Creek near Teckla, Wyoming, Gauging Station (06364700)

Constituent (units)	Aquatic Life		Human Health Consumption of Fish and Water	Maximum Measured Value
	Acute Value	Chronic Value		
Dissolved Oxygen (mg/L)[1]	No Limit for Class 3	No Limit for Class 3	-	11.7
pH (Min. – Max.)	-	6.4 – 9.0	-	8.4
Temperature (°F)	No Limit for Class 3	No Limit for Class 3	-	86
Sodium (mg/L)	-	-	-	308
Chloride (mg/L)	No Limit for Class 3	No Limit for Class 3	-	31.0
Aluminum (µg/L)[2]	750	87	-	< 100
Barium (µg/L)	-	-	2,000	300
Iron (µg/L)	-	1,000	300[3]	1,700
Manganese (µg/L)	7,992[4]	663[4]	500[3]	4,850

[1] Milligrams per liter (mg/L)
[2] Microgram per liter (µg/l)
[3] A criterion is based on Safe Drinking Water Act secondary standards and is intended to prevent undesirable cosmetic or aesthetic effects.
[4] Hardness dependent criteria. Criterion has been adjusted for a Hardness of 1,300 mg/L $CaCO_2$ according to the procedure provided in WDEQ 2013.

3.4.3 Groundwater

Groundwater occurs and is conveyed in underground aquifers that may consist of unconsolidated or consolidated materials. Unconsolidated aquifers are usually unconfined and generally found in the shallowest or most recent geologic formations in narrow valleys along major streams (USGS 1996). Unconsolidated aquifers may be present in the Project Area in the vicinity of Antelope Creek. Consolidated aquifers, which tend to be found in older geologic formations, are generally unconfined near outcrops and confined at greater depths beneath the surface. Multiple aquifers may underlie any given location. These aquifers not only may have distinct characteristics of geochemistry and hydrologic potential, but also may be recharged in different locations and flow in different directions. The consolidated aquifers beneath the Project Area consist of five large regional aquifer systems. From shallowest to deepest, these aquifer systems are the Lower Tertiary, Upper Cretaceous, Lower Cretaceous, Upper Paleozoic, and Lower Paleozoic aquifers (USGS 1996).

The quality of groundwater is largely determined by the concentration of dissolved solids. Groundwater quality ranges from freshwater with the least concentration of dissolved solids to brine with the greatest concentration of dissolved solids. Generally, groundwater in unconsolidated deposits and in the Lower Tertiary aquifers is considered potable (USGS 1996). The aquifers belonging to the lower tertiary aquifers include the Wasatch aquifers, the Fort Union aquifers contained in the Tongue River member of the Fort Union Formation, and the Tullock aquifer (BLM 2003). Within the Project Area the Upper Cretaceous aquifers are reported to contain between 1,000 to 3,000 mg/L dissolved solids and are considered slightly saline (USGS 1996). The Fox Hills formation which lies within the Upper cretaceous aquifer system is the deepest fresh water aquifer that could be penetrated to access the target formations for the proposed project. The Lower Cretaceous, Upper Paleozoic, and Lower Paleozoic aquifers contain moderately saline groundwater with approximately 3,000 to 10,000 mg/L dissolved solids (USGS 1996). In order to reach the target formations for this project, well bores would need to penetrate the Wasatch, Fort Union, Tullock, and Fox hills aquifers. Refer to Chapter 3 of the PRB FEIS for additional information on groundwater, pp. 3-1 to 3-36 (BLM 2003).

3.4.4 Hydrologic (Stormwater) Conditions

The USEPA describes stormwater runoff as generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground (USEPA 2015c). As stated in **Section 3.4.2**, the main streams in the Project Area include Antelope Creek and two tributaries to Antelope Creek: Bates Creek and Sand Creek. Project-related stormwater runoff would flow directly or indirectly into these streams. As stormwater flows over the land, it collects debris, sediment, trace metals or other pollutants, and debris which may degrade the water quality of water sources downstream. The degree of stormwater runoff is dependent on soil characteristics such as water erosion potential and erosion hazard rating, described in **Section 3.3.2.1** and **Section 3.3.2.3** respectively. Additionally, the removal of vegetation from a surface would increase the rate of runoff in a particular area, which may lead to an increase in erosion potential. The use of BMPs, proposed action design features, and facility siting are the primary method to control stormwater discharges (USEPA 2015c).

3.4.5 Floodplains

Floodplains are lowland areas that are susceptible to being inundated by flood waters from any source. The degree of flood within a floodplain is dependent upon the magnitude of flow or deluge within the adjacent water body. An area that has a one-percent or greater chance of flooding in any given year is known as a 100-year floodplain. The Federal Emergency Management Agency (FEMA) maintains boundaries of 100-year floodplains using flood hazard maps, also known as Flood Insurance Rate Maps. There are no FEMA regulated 100-year floodplains within the Project Area. Riparian and wetland communities are discussed in **Section 3.6.3**.

3.4.6 Waters of the United States

Under Section 404 of the CWA, the USACE retains the authority to regulate the discharge of dredged and fill material into Waters of the US. Waters of the US are defined within the CFR at Title 33 CFR 328.4. Title 33 CFR 328.4 provides the criteria for identifying the limits of potentially jurisdictional Waters of the U.S., whereas the limits of potential wetlands are defined and determined according to the USACE 1987 Wetlands Delineation Manual and the Regional Supplement to the USACE Delineation Manual: Great Plains Region (Version 2.0). While certain lands may meet the federal definition of Waters of the US, the USACE may not have regulatory jurisdiction over those areas due to lack of connectivity or other nexus to Waters of the US.

3.5 MINERAL RESOURCES

3.5.1 Locatable Minerals

Locatable minerals known to occur in the BLM CFO planning area include metallic (gold, silver, lead, platinum, copper, uranium, and chromite), and nonmetallic (talc, mica, white marble, building stone, fluorspar, chemical-grade limestone, gypsum, and bentonite) minerals (BLM 2007a). No locatable mineral mines are located within the Project Area. Three abandoned uranium mines and one permitted uranium mine are located north of the Project Area in Campbell County (Gregory 2014). The area north of the Project Area on the other side of the Campbell and Converse County border has been identified as having the potential for uranium exploration and production by the BFO (BLM 2013a).

3.5.2 Leasable Minerals

Approximately 94 oil wells, eight gas wells, and one CBNG well are present or have been approved within the Project Area. The type and status of the oil, gas, and CBNG wells in the Project Area are provided below in **Table 3.5.2-1,** and the location of existing and approved wells within the Project Area is depicted in **Figure 3.5.2-1**.

Table 3.5.2-1. Oil and Natural Gas Wells within the Project Area

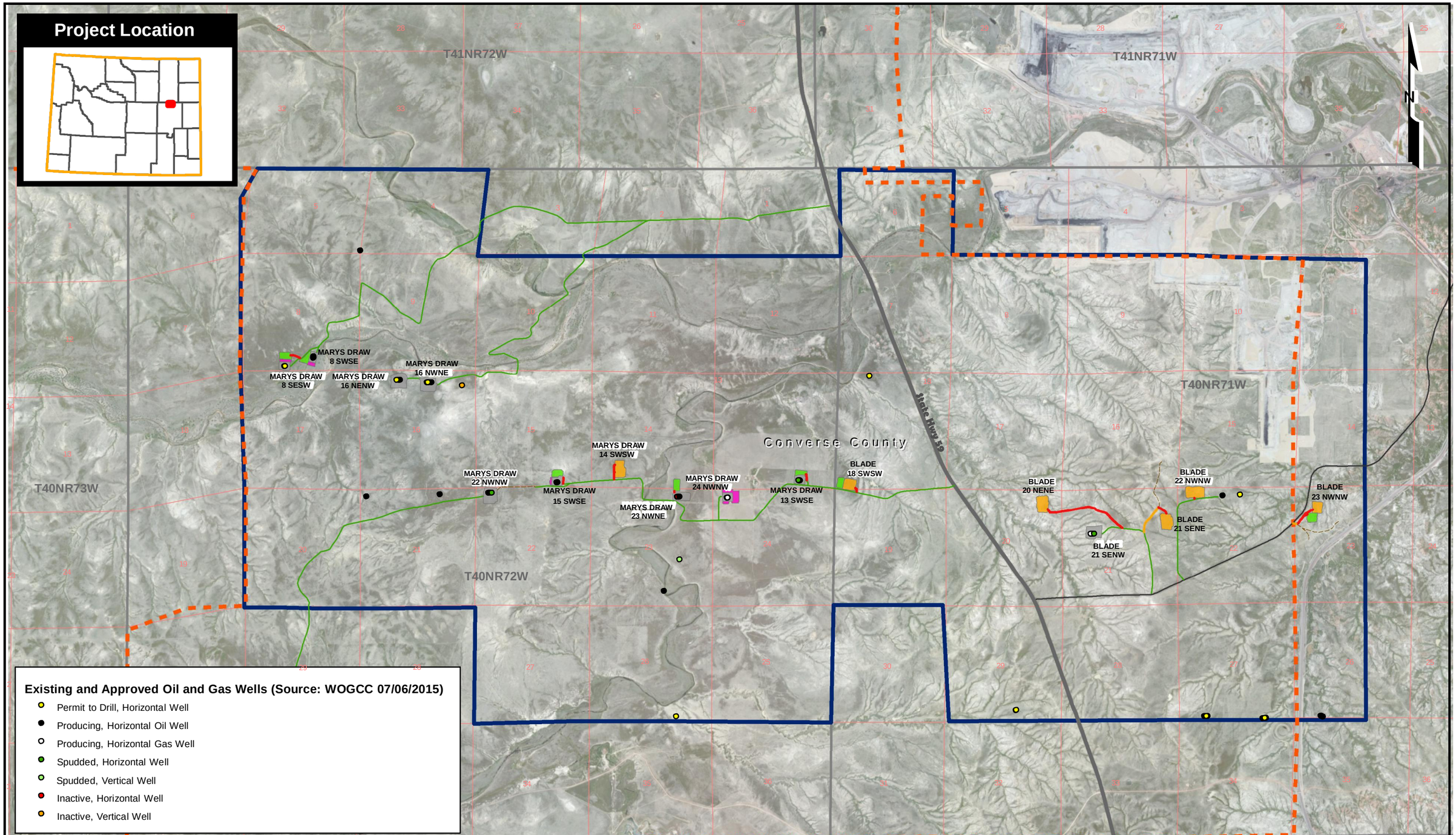
Well Status	Horizontal or Vertical	Well Type			Total
		Oil	Natural Gas	Coal Bed Natural Gas	
Inactive, Not-Producing	**Vertical**	0	0	1	**1**
	Horizontal	2	1	0	**3**
Active, Producing	**Vertical**	0	0	0	**0**
	Horizontal	32	5	0	**37**
Permit to Drill	**Vertical**	0	0	0	**0**
	Horizontal	60	2	0	**62**
Unknown Status/Other		-	-	-	**1**
Total		**94**	**8**	**1**	**103**

Source: WOGCC 2015a

The Robbins (DEEP) oil and gas unit (WYW 180090X Exploratory) managed by the WOGCC overlaps approximately 676.1 acres of the Project Area. There are four wells in the Robbins (DEEP) unit, which are all located just outside of the Project Area (WOGCC 2015a).

The Project Area is located within the Gillette Coal Field District. The Antelope Mine (**Figure 3.5.2-2**) is adjacent to the Project Area in T41N R71W (Jones et al. 2011), and is one of several mining operations nearby the Project Area. In 2012, a combined 29 percent of Wyoming's coal with a production of 141,955,502 tons was produced from the Gillette Coal Field District (WSGS 2014b). Sub-bituminous coal is extracted from the Upper Wyodak Anderson bed at these mines, from two seams that are between 36 and 80 feet thick.

Coal outcrops within the Project Area are displayed in **Figure 3.5.2.-2**. Approximately 23,805 acres of the Project Area are designated by the CFO as a Coal Development Potential Area. The remaining 480 acres of the Project Area are designated as unsuitable for coal development (BLM 2007a). While the eastern end of the project area is adjacent to an active coal lease, no portion of the project area is within a current lease or lease by application; coal mining is not reasonably foreseeable during the life of this project.



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FILE NAME:	3.5.2-1_ExistingOilAndGasWells.mxd

Crossbow 2016 Interim Drilling EA
Existing and Approved Oil and Gas Wells

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.5.2-1

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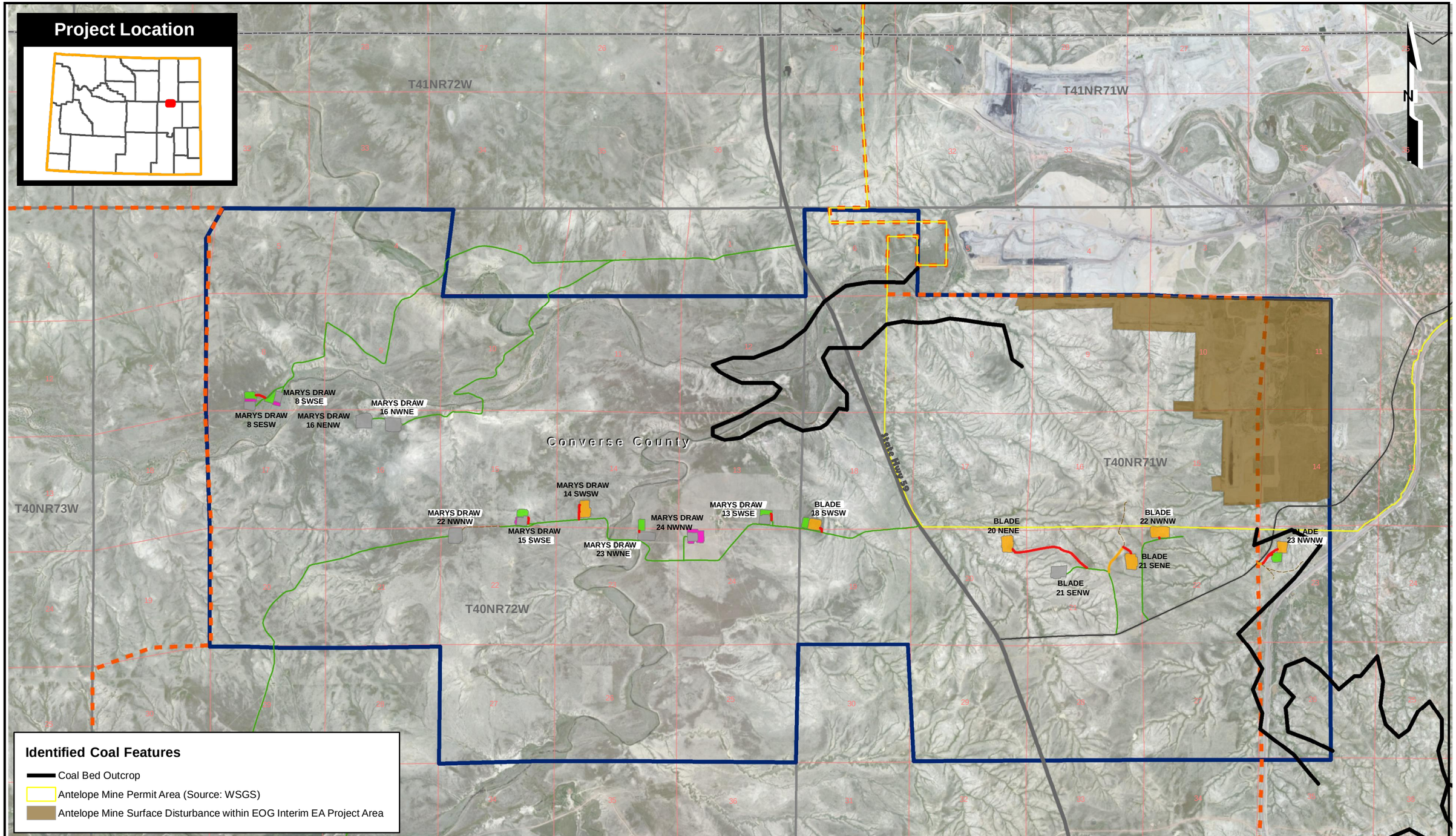

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Crossbow 2016 Interim Drilling EA
Identified Coal Features

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.5.2-2

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3.6 VEGETATION, INCLUDING GRASSLAND AND SHRUBLAND COMMUNITIES, RIPARIAN AND WETLAND COMMUNITIES, INVASIVE AND NONNATIVE PLANT SPECIES, PEST CONTROL, AND SPECIAL STATUS SPECIES

3.6.1 General Vegetation

The Project Area is located within the Omernik Level III "Northwestern Great Plains" Ecoregion (Omernik 1987). Encompassing portions of northeastern Wyoming, southeastern Montana, and the western side of the Dakotas, this region represents a semiarid rolling plain of shale and sandstone interspersed with buttes. The landscape generally consists of native grasslands in areas of broken topography and agricultural areas containing alfalfa and spring wheat on level ground. Agricultural development within these areas is limited by relatively low levels of precipitation and irrigation availability (USEPA 2013b).

The general vegetation distribution within the Project Area was mapped utilizing the NRCS Ecological Site Descriptions (ESDs). The entire Project Area falls within the Northern Rolling High Plains, Southern Part (58B) Major Land Resource Area (USDA-NRCS 2015). ESDs are differentiated based upon the following traits:

- Species and species group compositions;
- Prevalence of individual species within the characteristic plant community;
- Soil factors that determine plant production and composition, the hydrology of the site, and the functioning of the ecological processes of the water cycle, mineral cycles, and energy flow; and
- Differences in the kind, proportion, and production of the overstory and understory plants due to differences in soil, topography, climate, and environmental factors, or the response of vegetation to management (USDA-NRCS 2012).

Dominant or important ecological sites and plant communities within the Project Area are divided into 11 different ESDs. All of the ecological sites within the Project Area occur within the 10 to 14-inch Precipitation Zone. **Table 3.6.1-1** lists the ESDs mapped within the Project Area and **Figure 3.6.1-1** displays their spatial distribution within the Project Area.

Table 3.6.1-1. Ecological Site Descriptions of the Project Area

Ecological Site Description	Acres within the Project Area*	Percent within the Project Area*
Clayey (Cy) 10-14" Northern Plains Precipitation Zone	1,506.2	6.2
Clayey Overflow (CyO) 10-14" Northern Plains Precipitation Zone	19.7	0.0
Loamy (Ly) 10-14" 10-14" Northern Plains Precipitation Zone	8,806.2	36.3
Lowland (LL) 10-14" Northern Plains Precipitation Zone	1,869.1	7.7
Saline Upland (SU) 10-14" Northern Plains Precipitation Zone	111.2	0.5
Sands (Sa) 10-14" Northern Plains Precipitation Zone	2,134.4	8.8
Shallow Clayey (SwCy) 10-14" Northern Plains Precipitation Zone	215.5	0.9
Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone	8,224.6	33.9

Ecological Site Description	Acres within the Project Area*	Percent within the Project Area*
Shallow Sandy (SwSy) 10-14" Northern Plains Precipitation Zone	1,139.5	4.7
Very Shallow (VS) 10-14" Northern Plains Precipitation Zone	253.6	1.0
Water	4.6	0.0
Total	**24,284.6**	**100.0**

* Minor discrepancies may exist due to rounding

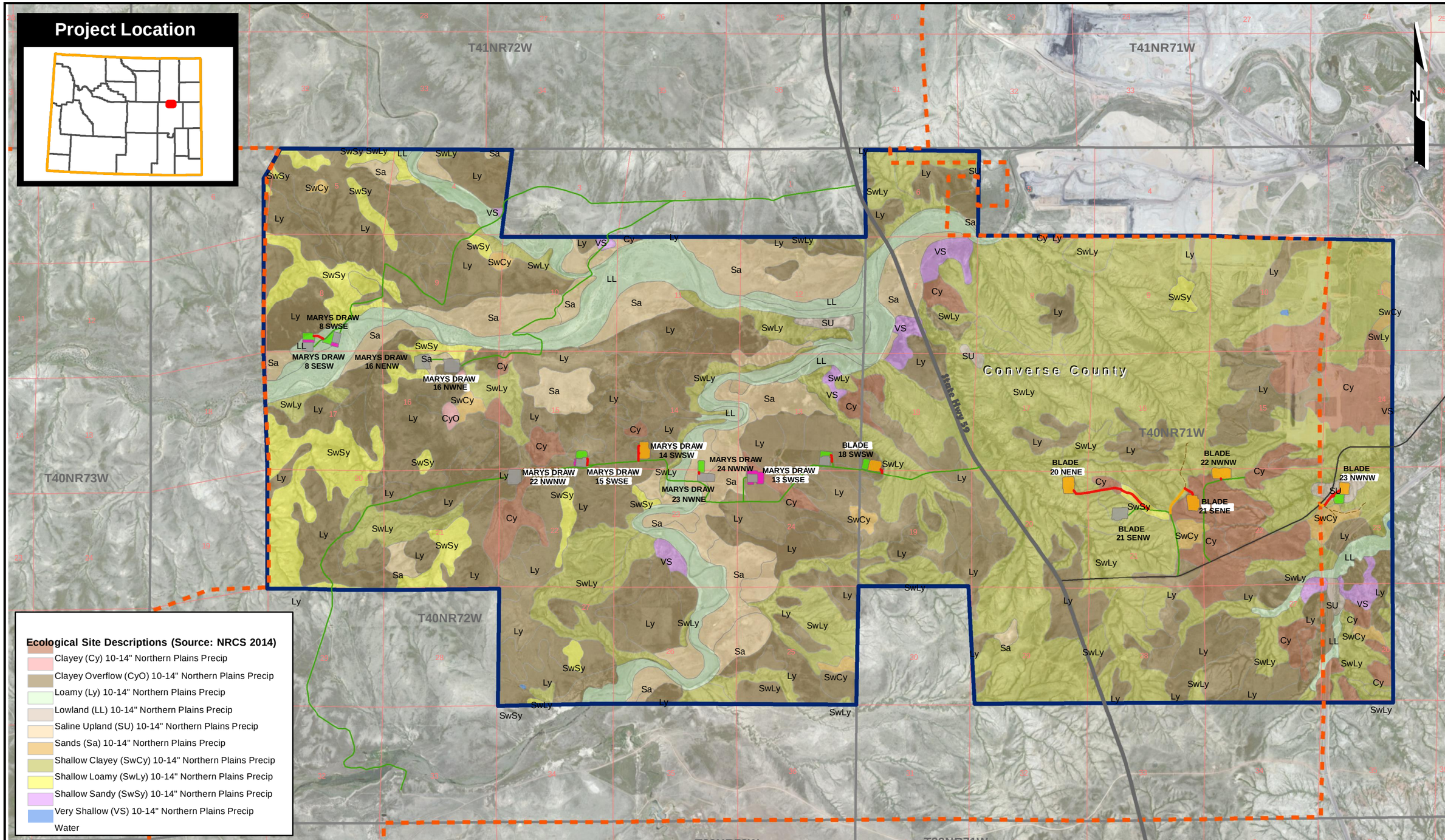
The dominant ESD present within the Project Area is Loamy (Ly) 10-14" Northern Plains Precipitation Zone which is listed as rangeland and accounts for approximately 8,806.2 acres (36.3 percent) of the Project Area. Approximately 75 percent of the vegetation associated with this ESD is grasses dominated by green needlegrass (*Nassella viridula*), needle and thread (*Hesperostipa 3-40omate*), and western wheatgrass (*Pascopyrum smithii*). Other grasses include Cusicks's bluegrass (*Poa cusickii*), Sandberg's bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and blue grama (*Bouteloua gracilis*). A variety of half-shrubs and forbs occur in this ESD. Big sagebrush is commonly scattered and represents up to 10 percent of the vegetation (USDA-NRCS 2011).

Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone is the second most abundant ESD and represents approximately 8,224.6 acres (33.9 percent) of the Project Area. This ESD is listed as rangeland and is dominated by cool season midgrasses. The major grasses include western wheatgrass, bluebunch wheatgrass, needle and thread, and little bluestem (*Schizachyrium scoparium*). Other grasses that may be present include Cusick's bluegrass, Sandberg's bluegrass, blue grama, and prairie Junegrass (*Koeleria macrantha*). Big sagebrush may occur in a scattered pattern and may be more prevalent in habitats that are devoid of natural fire (USDA-NRCS 2011).

It is important to note that while these descriptions and spatial boundaries may be used for land use planning, they may not provide precise assemblage of species and habitat characteristics at a given location, as they are used to portray distribution and composition across a landscape (USDA-NRCS 2012).

3.6.2 Grassland and Shrubland Communities

As stated in **Section 3.6.1**, the Project Area is within the "Northwestern Great Plains" Ecoregion. The USDA Forest Service characterizes the Northern Great Plains as having vegetation dominated by cool- and warm-season grasses, sedges, and forbs, with occasional shrubs (USDA-Forest Service 2015). Grasslands are used by bison, elk, deer, antelope, and prairie dogs to graze. Tilled croplands, hay pastures, and agricultural grazing lands are additional uses of grasslands (USDA-Forest Service 2015). Shrubs within the Northern Great Plains region, specifically, in northeastern Wyoming, are dominated by big sagebrush, which is often accompanied by dwarf sagebrush and rabbitbrush species. Other shrubs such as saltbushes, greasewood, and winterfat can become a major portion of the cover (Shiflet 1994).



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Project Area Boundary: EOG (2015)

- 2015 Interim EA Project Area

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FILE NAME:	3.6.1-1_EcologicalSites.mxd

Crossbow 2016 Interim Drilling EA
Ecological Site Descriptions

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.6.1-1

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3.6.3 Riparian and Wetland Communities

In addition to mapped streams, **Figure 3.4.2-1** also depicts National Wetland Inventory (NWI)-mapped wetlands within the Project Area. Approximately 64.1 acres of freshwater emergent wetlands, 16.9 acres of freshwater ponds, and 47.3 acres of riverine areas occur within the Project Area. Site-specific ground surveys would be required to verify the existence of these NWI wetlands, in addition to determining if these features and other existing wetlands would be considered potentially jurisdictional.

3.6.4 Invasive and Noxious Weeds and Pest Control

Noxious and invasive weed species can out-compete native plants and are considered a detriment to their introduced environment. The introduction of noxious species and the loss of native vegetation can result in an economic loss and a reduction in rangeland productivity, reduced structural and species diversity, and reduction in surrounding habitat quality (BLM 2007a). As agriculture is the predominant land use within Converse County, it is important for noxious and invasive weeds to be controlled within the county (Converse County 2003). Noxious and invasive weed species are most common along disturbance corridors and in areas with recurrent disturbance, such as roads, grazing allotments, and areas subject to wildfire (Gelbard and Belnap 2003). Noxious weeds, such as cheatgrass (*Bromus tectorum*), have the potential to alter the fire regimes in their introduced environments and can increase fire sensitivity and fire return intervals (Balch et al. 2013).

No state-listed noxious or invasive plant infestations were found by reviewing inventory maps, databases, or during field investigations. Cheatgrass, and to a lesser extent, Japanese brome exist in the Project Area, but not at a major infestation level. These species are common in high densities and in numerous locations in northeast Wyoming. Studies in the semi-arid west show invasive and noxious weed infestations measurably increase out to 0.5 miles or more from surface disturbances (Gelbard 2003, Duniway 2010) and cheat grass infestations increase the likelihood and severity of wildfire (Balch 2013).

3.6.5 Special Status Plant Species

3.6.5.1 Federally Threatened, Endangered, and Candidate Species

Under Section 7(a)(2) of the ESA, the USFWS is required to consult on and ensure that any action that is implemented, authorized, or funded by the federal government does not jeopardize the continued existence of any federally listed species, or adversely alter or remove habitat for the listed species (USFWS 1973).

The USFWS has listed four plant species in Wyoming as threatened or endangered under the ESA (USFWS 2015). The potential for each federally protected plant species to occur within the Project Area was assessed based on habitat requirements (geologic formations, elevation range, and soil requirements) and known distribution. Based on these criteria, only the Ute ladies'-tresses (*Spiranthes diluvialis*) has the potential to occur within the Project Area. Refer to **Appendix C**, *Summary of the Potential for and/or Occurrence of Special Status Wildlife and Plant Species within the Project Area*, for the analysis of all special status species considered during this project and their potential to occur within the vicinity of the Project Area.

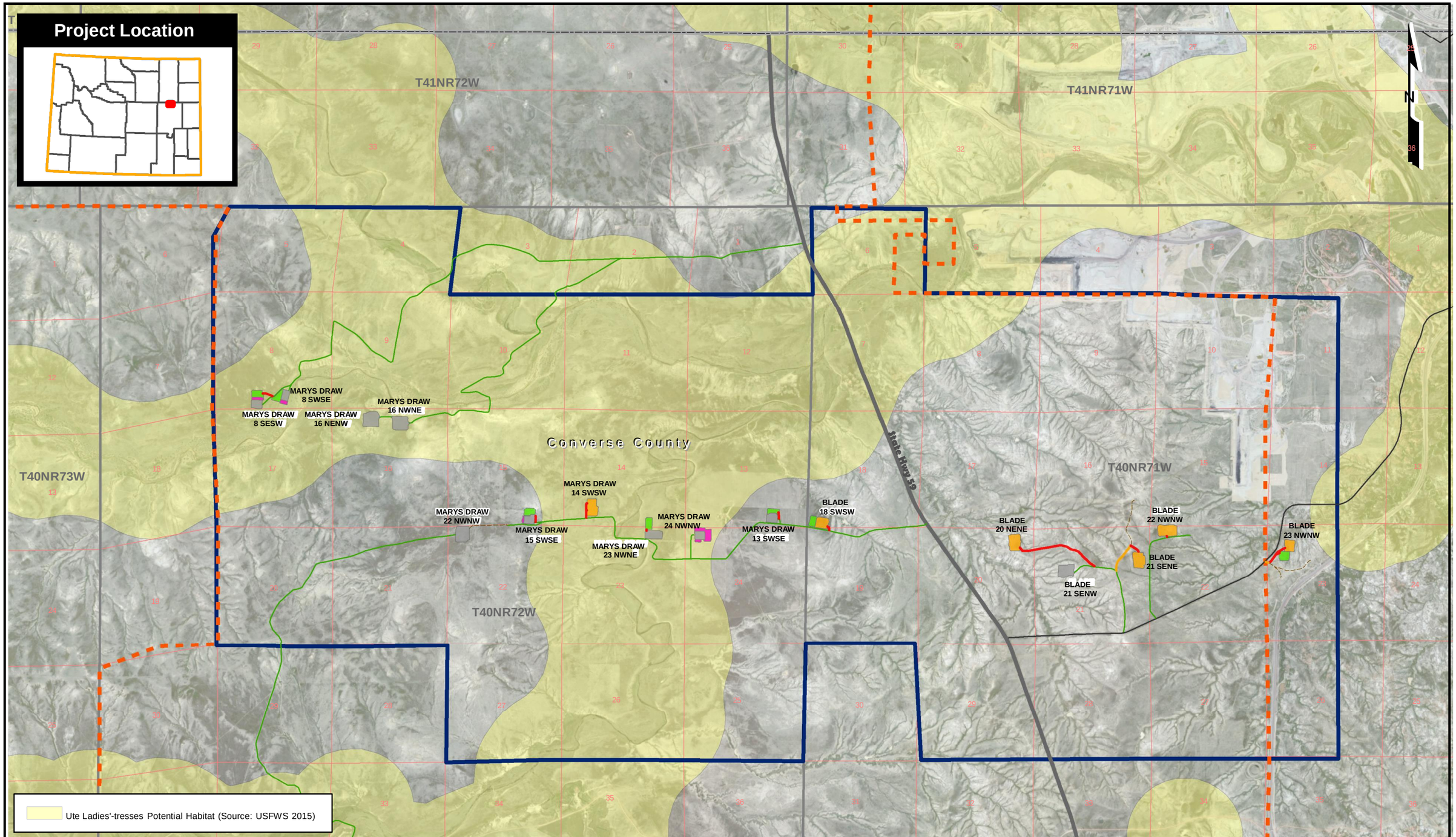
3.6.5.1.1 Ute Ladies'-Tresses

The Ute ladies'-tresses was listed as a federally threatened species under the ESA in 1992 and as a BLM sensitive species in Wyoming (USFWS 1992a; BLM 2014b). Within Wyoming, Ute ladies'-tresses are generally located at the base of the eastern slope of the Rocky Mountains in moist valley bottoms where small perennial streams are fed by groundwater (Heidel et al. 2008). Habitat for this species occurs along riparian edges, gravel pits, oxbows, high flow channels, and moist to wet meadows adjacent to perennial streams. It often occurs within stable wetlands and areas with consistent moisture or water flow, such as those found near or within floodplains, lakes, and springs (USFWS 2010). The species occurs in areas where vegetation is open and not overgrown or overgrazed, and grows in soils that are characterized as sandy loams, sand, loams, and silt loams (USFWS 1992a; Fertig and Heidel 2007). Soils within potential habitat are moist throughout the year and are low in dissolved minerals and clay, but high in calcium content (Heidel et al. 2008).

In Wyoming, Ute ladies'-tresses are known to flower from very late July to mid-September. However, flowering times differ between site, between years, and between individuals of the same population. Overall, all Wyoming populations show peak flowering during August (Heidel 2007). Bumblebees serve as the primary vector for pollination. Dominant vegetation often found with Ute ladies'-tresses include redtop (*Agrostis stolonifera*), switchgrass (*Panicum virgatum*), Baltic rush (*Juncus balticus*), and/or few-flowered spikerush (*Eleocharis quinqueflora*) (Heidel et al. 2008). Seed are primarily dispersed via the wind (USFWS, n.d.). Existing threats to the Ute ladies'-tresses include water developments, intense domestic livestock grazing, hay mowing, competition from noxious and invasive weed species, habitat fragmentation due to urbanization, and collection by humans (USFWS 1992a).

Potential Ute ladies'-tresses habitat has been identified within the Project Area. Antelope Creek and two tributaries to Antelope Creek, Bates Creek and Sand Creek, flow through the Project Area providing riparian habitats and creating adjacent NWI wetland areas in the Project Area (**Figure 3.6.5.1-1**). One of the four previously recorded locations of Ute ladies'-tresses in Wyoming is found within the Antelope Creek Drainage in northeast Converse County, upstream and west of the Project Area; however, no known populations occur within the Project Area (Fertig and Heidel 2007). In addition to the population recorded by Fertig and Heidel, HWA biologists identified a population along Sand Creek approximately 8 miles southwest of the Project Area, as well as a substantial number of populations along tributaries of Antelope Creek approximately 14 miles west of the Project Area (HWA 2015b). Other surveys have also identified several populations 12 to 14 miles west of the Project Area (HWA 2015b).

Based on the potential for the species to occupy the Project Area, EOG directed HWA to conduct Ute ladies'-tresses presence/absence surveys with the Project Area and surrounding areas in 2014 and 2015. Potential habitat was determined from USGS topographic maps and National Agriculture Imagery Program aerial photographs from 2012. Surveys were conducted from August 11 to 14, 2014, within previously identified areas of potential habitat during the Ute ladies'-tresses survey window following recommendations and guidelines criteria outlined by the USFWS (USFWS 1992b, 1995). Additional surveys were conducted on June 28, 2015, June 30, 2015, and July 1 – 2, 2015. These surveys were conducted outside of the 2015 survey window designated by the BLM CFO, when local populations are in bloom; therefore, only potential habitat was evaluated.



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FILE NAME:	3.6.5.1-1_UteLadiesTressesHabitat.mxd

Crossbow 2016 Interim Drilling EA
Ute Ladies'-tresses Potential Habitat

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.6.5.1-1

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The 2014 and 2015 habitat surveys identified 17 areas of suitable habitat in the Project Area, all of which were classified as marginal (HWA 2014, 2015a). Approximately 58.9 acres of marginally suitable habitat occurs within the Project Area (Personal Communication with Lauren Throop Clabby, 08/24/15, HWA 2015b). Of the 17 marginal sites, eight were surveyed for Ute ladies'-tresses individuals during the 2014 presence/absence survey. During the 2015 presence/absence survey, which was conducted on August 10, 2015, 13 of the 17 marginal sites were surveyed for Ute ladies'-tresses individuals. No Ute ladies'-tresses individuals were identified during the 2014 or 2015 presence/absence surveys (HWA 2014, 2015b). Four marginal sites (approximately 22.3 acres of marginally suitable habitat) were not surveyed for Ute ladies'-tresses individuals during the 2015 presence/absence survey due to private landowner access restrictions. However, surveys conducted in previous years (i.e., surveys conducted in 2010, 2011, 2012, 2013, and 2014) in those areas did not identify Ute ladies'-tresses populations (HWA 2015b).

3.6.5.2 BLM and USFS Sensitive Species

In addition to species protected under the ESA, USFS Region 2 sensitive species are known to occupy the Project Area. USFS sensitive species are defined as "Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species existing distribution" (USFS 2002). While the USFS identifies 88 sensitive species within the Region 2 Planning Area, only one plant species was identified as potentially being present within the Project Area based on habitat requirements and occupied range (USFS 2013; Wyoming Natural Diversity Database [WYNDD] 2014). Species life history and habitat requirements for the Barr's milkvetch (*Astragalus barrii*) are described below. No BLM Wyoming Sensitive Species were identified as potentially occurring within the Project Area. The BLM sensitive species removed from detailed analysis can be found in **Appendix C**, *Summary of the Potential for and/or the Occurrence of Special Status Wildlife and Plant Species within the Project Area*.

3.6.5.2.1 Barr's Milkvetch

Barr's milkvetch is currently listed as a USFS Region 2 sensitive species. Barr's milkvetch is regionally endemic to the plains of southwestern South Dakota, eastern Wyoming, southeastern Montana, and northwestern Nebraska. Within Wyoming it has been observed in Natrona, Niobrara, Converse, Weston, Johnson, and Campbell Counties. Approximately 75 percent of known Barr's milkvetch occurrences occur in the PRB in southeastern Montana and northeastern Wyoming (Ladyman 2006). Habitat for this species is described as dry, rocky prairie knolls, hillsides, and barren areas where the surface runoff is high (Schmoller 1995; USFS 2015). Specifically, in Wyoming this species is found most frequently on sparsely vegetated badlands and breaks, often on whitish, sandy-silty or sandy soils at elevations of 3,700 to 5,700 feet (USFS 2015). Geologic formations associated with potential habitat for the Barr's milkvetch include the Cody Shale Formation and Wasatch Formation. Plant communities associated with Barr's milkvetch in its northern Wyoming range include greasewood (*Sarcobatus*), shadscale-sagebrush (*Atriplex-Artemisia*), big sagebrush-shadscale-western wheatgrass (*Artemisia-Atriplex-Agropyron*), big sagebrush-western wheatgrass (*Artemisia-Agropyron*), and skunkbush sumac-western wheatgrass (*Rhus-Agropyron*) and have bare ground components that are 50 percent or larger of the ground cover (Brown 1971; Ladyman 2006). Flowering for this perennial occurs from late April to mid-June. Existing threats to the Barr's milkvetch throughout the USFS Region 2 planning area include resource extraction, recreational activities, urbanization and development, grazing, and noxious weed invasion (Ladyman 2006).

Barr's milkvetch has been observed within the Antelope Creek Watershed, and has been observed in 12 separate locations within administrative boundaries of the TBNG (Ladyman 2006). The USFS is currently working on methods to survey and map potential habitat for this species within Wyoming. The WYNDD has mapped potential Barr's milkvetch habitat within the eastern portion of the Project Area (**Figure 3.6.5.2-1**). Additionally, the Barr's milkvetch has been observed within the boundaries of the Project Area.

3.7 FISH AND WILDLIFE, INCLUDING SPECIAL STATUS SPECIES

Information regarding the recent and historic observations of various fish and wildlife species within the Project Area was obtained from the Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming (Orabona et al. 2012). The WGFD Wildlife Observation System (WOS) and WYNDD are the primary sources of information on wildlife populations and distribution in Wyoming. While many species of birds, mammals, herptiles, and fish are important members of their respective ecosystems, most are regionally abundant and are considered common. Accordingly, the relationship of these species to the Project Area is not discussed in the same detail as those that are considered as threatened, endangered, sensitive, of special economic interest, or are otherwise of high interest to the BLM.

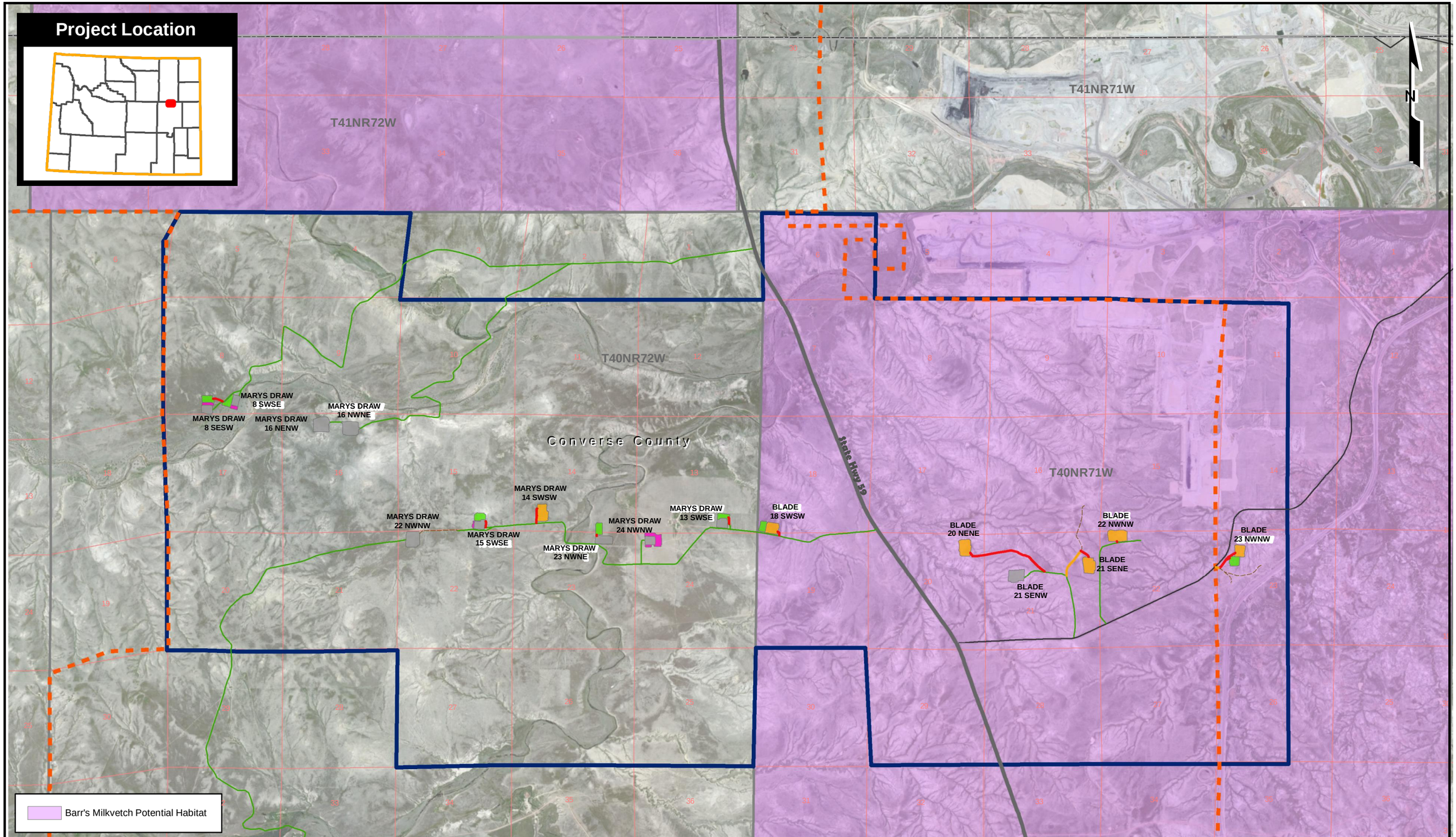
3.7.1 Wildlife Habitats

Habitat features within the Project Area are discussed in detail within the resource analyses for vegetation and soils (**Sections 3.3** and **3.6**, respectively). Some areas within the Project Area are identified as priority areas for conservation action or as high quality habitats by the WGFD. These habitats are shown in **Figures 3.7.1-1 and 3.7.1-2**.

3.7.1.1 Wyoming Game and Fish Department Habitat Priority Areas

Under the WGFD Strategic Habitat Plan (SHP), several areas within Wyoming that contain habitat with significant regional value for fish and wildlife species and/or habitat that requires enhancement were identified as priority habitat areas. Depending on the type of habitat, these priority habitat areas are identified by the Fish Division, Terrestrial Habitat Division, and the Habitat Access and Maintenance Division of the WGFD. Priority habitat areas are classified based on their conformance to one of two goals under the SHP:

1. Conserve and manage wildlife habitats that are crucial for maintaining terrestrial and aquatic wildlife populations for the present and future.
2. Enhance, improve, and manage priority wildlife habitats that have been degraded (WGFD 2009).



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FILE NAME:	3.6.5.2-1_BarrsMilkvetch.mxd

Crossbow 2016 Interim Drilling EA
Barrs Milkvetch Potential Habitat

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.6.5.2-1

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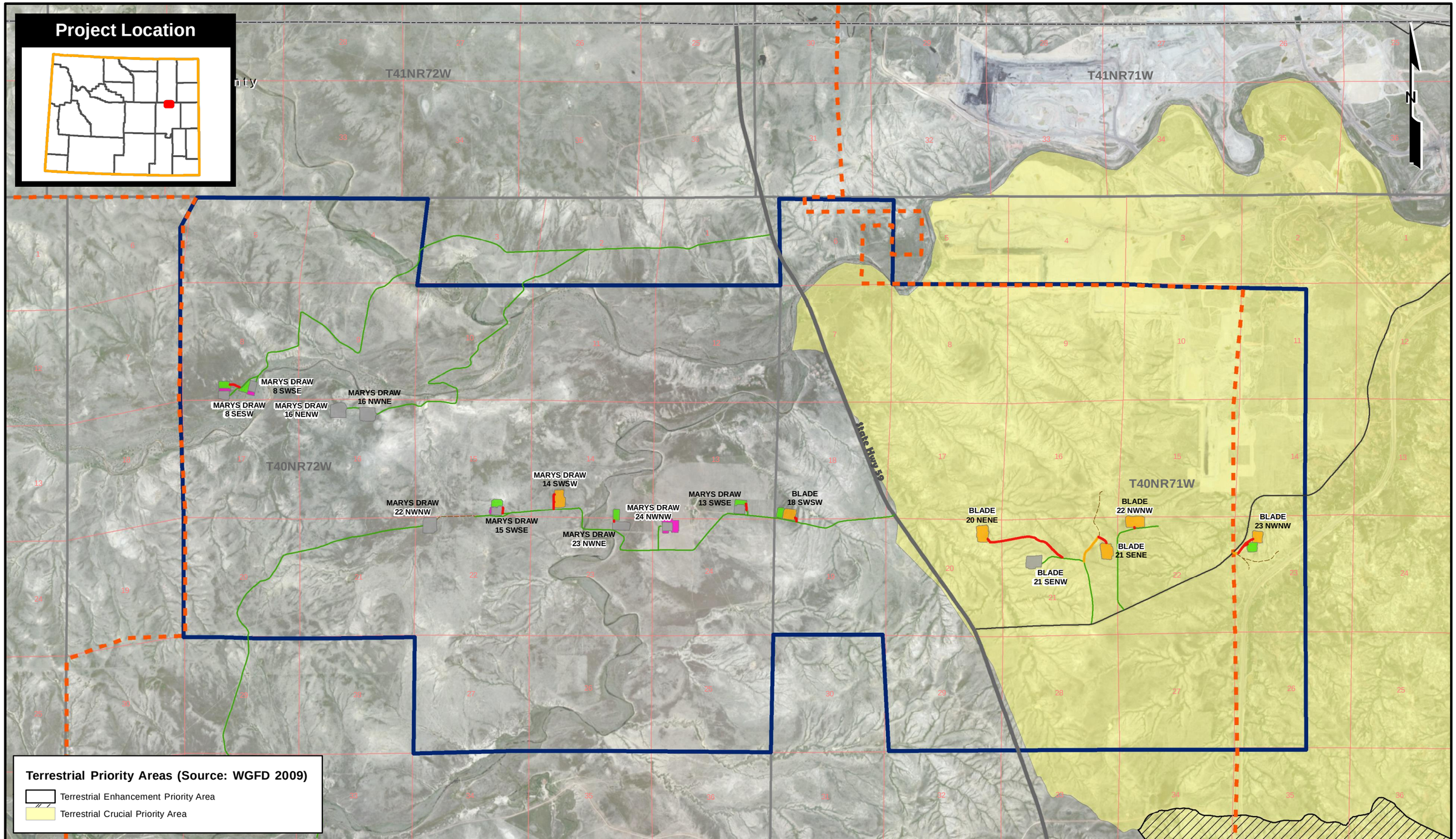

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Crossbow 2016 Interim Drilling EA
Terrestrial Crucial Priority Areas

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FIGURE
3.7.1-1

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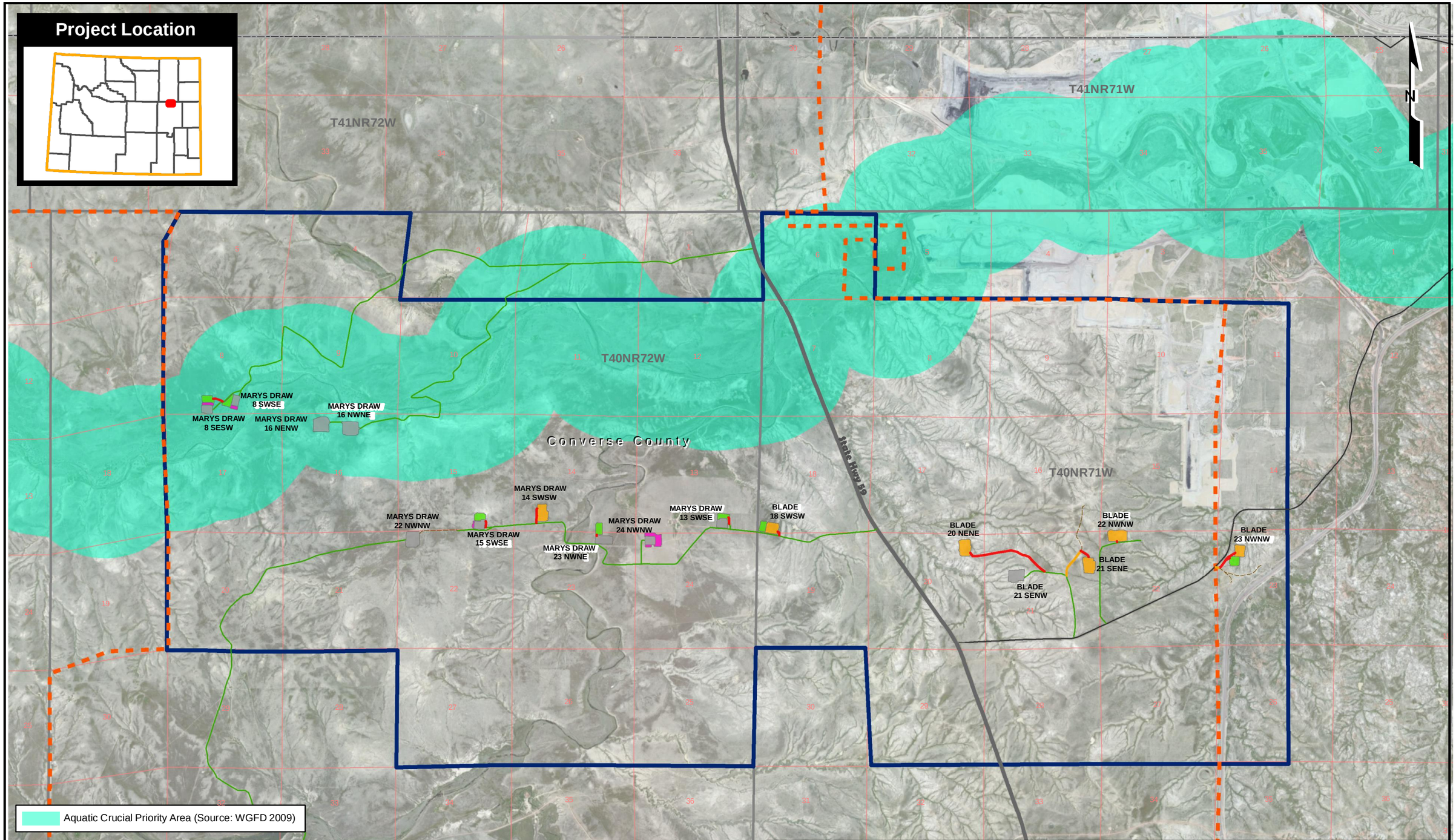

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FILE NAME:	3.7.1-2_AquaticPriorityArea.mxd

Crossbow 2016 Interim Drilling EA
Aquatic Crucial Priority Areas

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Converse County, Wyoming

FIGURE
3.7.1-2

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Habitats that meet the criteria identified under Goal 1 are designated as "crucial habitat priority areas." Habitats falling under the description of Goal 2 are designated as "enhancement habitat priority areas." A single habitat priority area can be designated as both crucial and enhancement, if both criteria are met (WGFD 2009). Habitat priority areas found within the Project Area are listed below in **Table 3.7.1.1-1**.

Table 3.7.1.1-1. WGFD Habitat Priority Areas in the Project Area

Name	Acres in Project Area	Reason for Designation
Terrestrial Crucial Habitat Priority Area		
Thunder Basin	8,856	Contains a unique combination of habitat values, vegetation community diversity, and wildlife species diversity.
Aquatic Crucial Habitat Priority Area		
Prairie Stream and Riparian Corridors	5,871	Area supports cottonwood canopies that stabilize stream banks, shades stream habitats, and maintains in-stream habitats that can be used for riparian and upland species.

3.7.1.2 WGFD Terrestrial Conservation Areas

The WGFD has identified approximately 482 acres within the Project Area as a Terrestrial Conservation Area as part of the 2010 State Wildlife Action Plan (SWAP). While this area does not recommend protections for specific Wyoming Species of greatest Conservation Need (SGCN), it is identified as an area that can meet the conservation targets for multiple SGCN for a low cost. This terrestrial conservation area is used by the state to identify high value habitat in the land planning process (WGFD 2010a).

3.7.2 Big Game

Four big game species are known to inhabit the Project Area either year-round or on a seasonal basis; these species include pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), and Rocky Mountain elk (*Cervus elaphus*). Big game populations in Wyoming are managed by the WGFD while their habitats are managed by the surface owner. Regional populations of each big game species are managed with "herd units," and are further subdivided into "hunt units." Hunt units represent boundaries for recreational hunting licenses. The WGFD releases Job Completion Reports (JCR) annually that state population estimates, hunt statistics, and habitat reviews. **Table 3.7.2-1** lists the herd units and population statistics for each big game species known to inhabit the Project Area.

Table 3.7.2-1. Big Game Herd Unit Statistics

Species	Herd Unit	Hunt Unit(s)	Acres in Project Area	2008 - 2012 Population Average (Estimate)	Population Estimate 2013	WGFD Population Objective	Percent Over or Under
Elk	Rochelle Hills	113	9,244	N/A	750	N/A	N/A
	N/A	126	15,041	N/A	N/A	N/A	N/A
Total			***24,285***	**--**	**--**	**--**	**--**
Pronghorn	Cheyenne River	27	15,041	35,973	26,508	38,000	-30.2
	North Converse	26	9,244	32,516	28,114	28,000	0.4
Total			***24,285***	***68,489***	***54,622***	**--**	**--**
Mule Deer	Cheyenne River	10	15,041	19,005	18,180	38,000	-52.2
	North Converse	22	9,244	8,383	6,775	9,100	-25.5
Total			***24,285***	***27,388***	***24,955***	**--**	**--**
White-tailed Deer	Central	10, 22	24,285	N/A	N/A	N/A	N/A
Total			***24,285***	**--**	**--**	**--**	**--**

Source: WGFD 2014a; WGFD 2014b; WGFD 2014c

The WGFD maps crucial and substantial habitat ranges for big game species based on the quality of habitat and its value to regional populations. No crucial big game ranges for any species are located within the Project Area. A description of each substantial range type known to occur within the Project Area can be found below.

- *Severe Winter Relief* habitat is a documented survival range that is used, to a great extent, only in extremely severe winters. It might lack habitat characteristics that would make it attractive or capable of supporting a larger segment of the population during normal years, but is used by and allows at least a substantial portion of the population to survive the occasional extremely severe winter.
- *Winter/Year-long* habitat is an area where a population or a portion of a population of animals makes general use of on a year round basis. During the winter months, additional animals may migrate to the area from other seasonal ranges.
- *Year-long* habitat is located in areas where a population of animals makes general use of suitable documented habitat sites on a year-round basis (BLM 2013a).

The acreages for each of these big game ranges within the Project Area are listed in **Table 3.7.2-2**.

Table 3.7.2-2. Big Game Ranges within the Project Area

Name	Seasonal	Acres in Project Area	Percent of Project Area
Pronghorn	Severe Winter Relief	2,470	10.2
	Winter/Year-long	2,039	8.4
	Year-long	19,775	81.4
Mule Deer	Winter/Year-long	8,531	35.1
	Year-long	15,753	64.9
White-tailed Deer	Year-long	1,812	7.5

Source: WGFD 2014a

3.7.2.1 Rocky Mountain Elk

Elk generally inhabit coniferous forests, mountain meadows, short- and mixed-grass prairies, sagebrush, and shrubland habitats within Wyoming. Food sources vary seasonally depending on availability and are primarily composed of browse, grasses, and forbs. The Rochelle Hills herd unit is the only WGFD herd unit within the Project Area and contains Hunt Unit 113 (Rochelle Hills). This unit occupies approximately 9,244 acres in the eastern half of the Project Area. While the area in the eastern half of the Project Area is listed as the Lost Springs hunt unit, no herd unit is listed for this area and no population estimate data is available. Currently, the population estimate for the Rochelle Hills herd unit is 750 individuals (WGFD 2014b; WGFD 2014c). While elk populations typically migrate between summer and winter range, the Rochelle Hills herd unit is considered non-migratory. No WGFD crucial or seasonal habitat ranges for elk are within the Project Area.

3.7.2.2 Pronghorn

Pronghorn are most common in short- and mixed-grass prairies of the western U.S., but can also inhabit semi-desert grasslands and shrublands (BLM 2013a). Depending on the climatic conditions, forage availability, rangeland management activities, and population dynamics pronghorn home ranges can vary from 400 to 5,600 acres. Annually, pronghorn migrate between their summer and winter ranges. Migration is often based on the availability of succulent vegetation rather than shifts in weather patterns (Fitzgerald et al 1994).

As shown in **Table 3.7.2-2**, both pronghorn herd units within the Project Area, the Cheyenne River and North Converse, have estimated populations of approximately 26,508 and 28,114 animals, respectively. While the North Converse population is meeting its population objective, the Cheyenne River herd unit is currently 30.2 percent below its current population objective. This is due to a recent increase in doe harvests, reduction in fawn recruitment, and an increase in non-hunting related mortality of adults (WGFD 2014c).

The WGFD has identified approximately 2,470 acres and 2,039 acres of the Project Area as severe winter relief and winter/year-long habitat for pronghorn, respectively (WGFD 2014a). The remainder of the Project Area is mapped as year-long pronghorn habitat, which accounts for approximately 19,775 acres of the total Project Area acreage. WGFD delineated habitats for pronghorn are shown in **Figure 3.7.2.2-1**.

3.7.2.3 Mule Deer

Within Wyoming, mule deer inhabit montane habitats, broken hill country, and prairie grasslands and shrublands (Clark and Stromberg 1987). Browse is the mule deer's primary food source, which is supplemented with grasses and forbs. Mule deer generally move from higher elevation habitats in the summer to lower elevation areas with more cover in winter (Fitzgerald et al 1994).

As shown in **Table 3.7.2-2**, both mule deer herd units in the Project Area, the Cheyenne River and North Converse, are below their population objectives by 52.2 and 25.5 percent, respectively. The Cheyenne River herd unit has experienced a population decline since 2000 as a result of severe weather and drought conditions. Lower levels of cottonwood regeneration have also had an impact on this herd unit. The North Converse herd unit has experienced more recent declines from a winter mortality event in 2010 (WGFD 2014c).

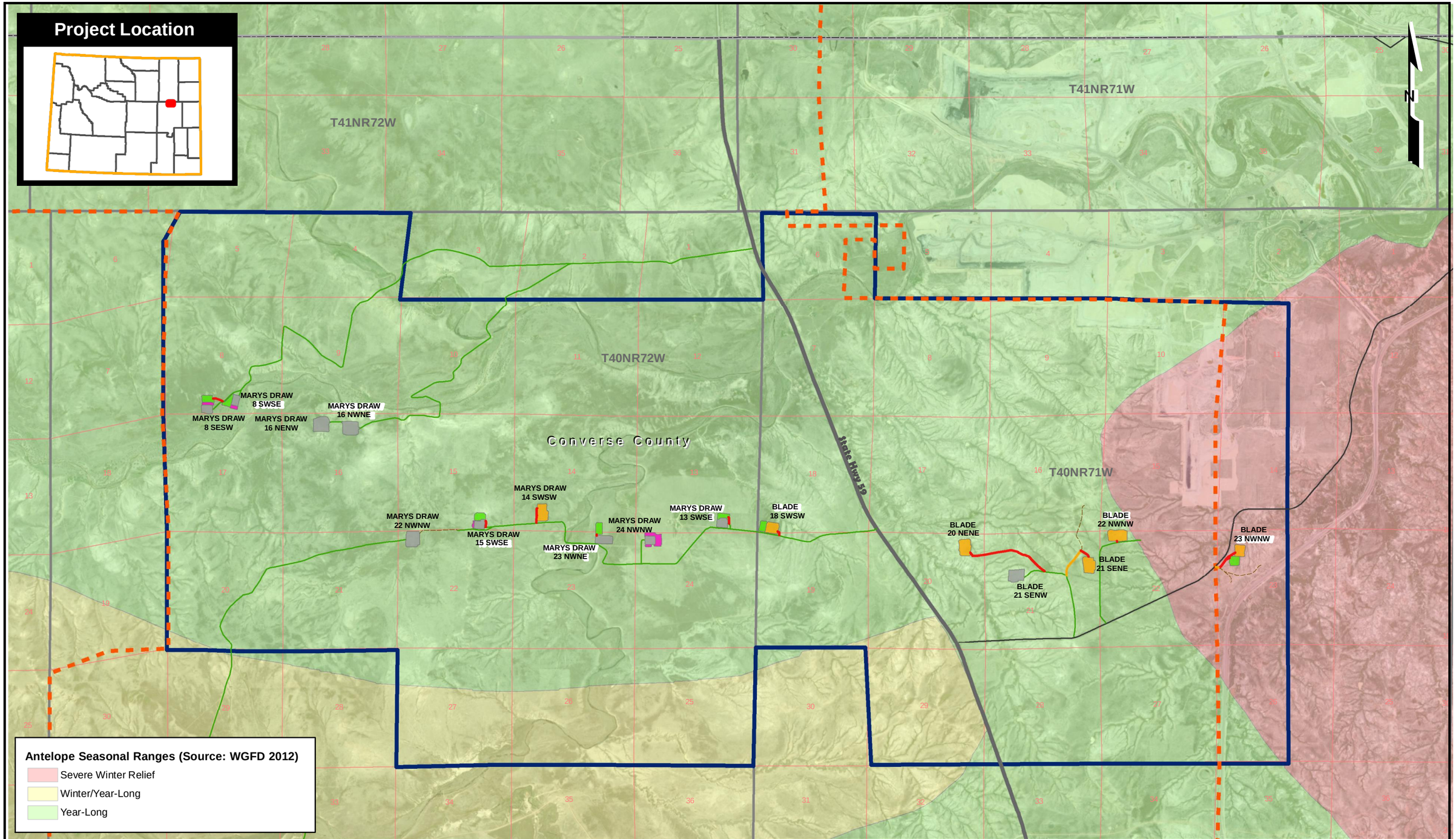
Approximately 8,531 and 15,753 acres of the Project Area are identified as winter/year-long and year-long habitats, respectively (WGFD 2014a). WGFD delineated habitats for mule deer are shown in **Figure 3.7.2.3-1**.

3.7.2.4 White-tailed Deer

Habitat for white-tailed deer generally consists of riparian woodlands, shrubby riparian areas, and irrigated agricultural lands, while dry grasslands and coniferous forests are usually avoided (Clark and Stromberg 1987). Some major components of the white-tailed deer diet include agricultural crops, fruits, acorns, and other nuts (Fitzgerald et al 1994). White-tailed deer within the Project Area belong to the Central herd unit. This herd unit has a management objective that is a post-season ratio of greater than 20 bucks per doe. The 2013 post season male to female ratio for the Central herd unit was estimated at 43, which is exceeding the objective by 115 percent (WGFD 2014c). Approximately 1,812 acres of year-long habitat for white-tailed deer occurs along the Antelope Creek riparian corridor (WGFD 2014a). WGFD delineated habitats for white-tailed deer are shown in **Figure 3.7.2.4-1**.

3.7.3 Upland Game

Upland game bird species with a potential to inhabit the Project Area include the greater sage-grouse, mourning dove (*Zenaida macroura*), gray partridge (*Perdix perdix*), ring-necked pheasant (*Phasianus colchicus*), sharp-tailed grouse (*Tympanuchus phasianellus*), Hungarian partridge (*Perdix perdix*), and wild turkey (*Meleagris gallopavo*). Small game mammal species known to inhabit the Project Area include cottontails (*Sylvilagus* spp.), snowshoe hares (*Lepus americanus*), red squirrels (*Tamiasciurus hudsonicus*), gray squirrels (*Sciurus carolinensis*), and fox squirrels (*Sciurus niger*). Habitat for these species is found in grassland-prairie, riparian, and sagebrush habitats throughout the Project Area. Upland and small game species in Wyoming are managed by the WGFD (Orabona et al. 2012). No known sharp-tailed grouse leks are within the Project Area. As the greater sage-grouse is a Candidate species under the ESA and a BLM and USFS sensitive species, it will be discussed in detail in **Section 3.7.6.1.1**.



0 0.25 0.5 1 Miles

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- Proposed Facilities Pad
- Proposed Pad Expansion
- Existing Well Pad
- Proposed Access Road
- Proposed Road Upgrade
- Highway
- County Road
- Existing Access Road
- Existing Two-track
- Greater Crossbow EIS Project Area
- County Boundary
- Township/Range Boundary
- Section Boundary

Project Area Boundary: EOG (2015)

- 2015 Interim EA Project Area

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DRAWN:	12/30/2015
DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	3.7.2.2-1_AntelopeHabitat.mxd

Crossbow 2016 Interim Drilling EA
Antelope Seasonal Habitat

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.7.2.2-1

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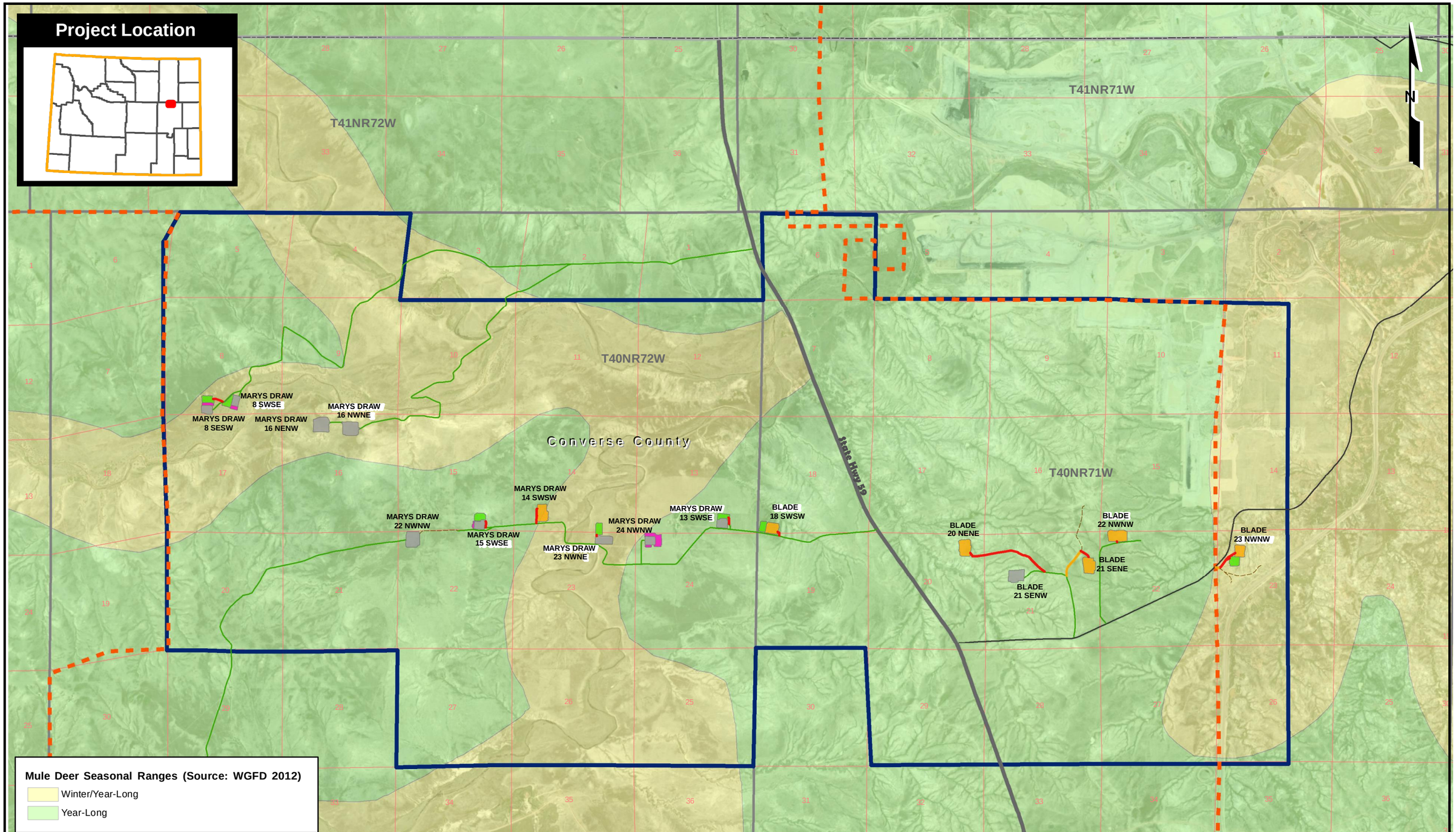

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DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	3.7.2.3-1_MuledeerHabitat.mxd

Crossbow 2016 Interim Drilling EA
Mule Deer Seasonal Habitat

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.7.2.3-1

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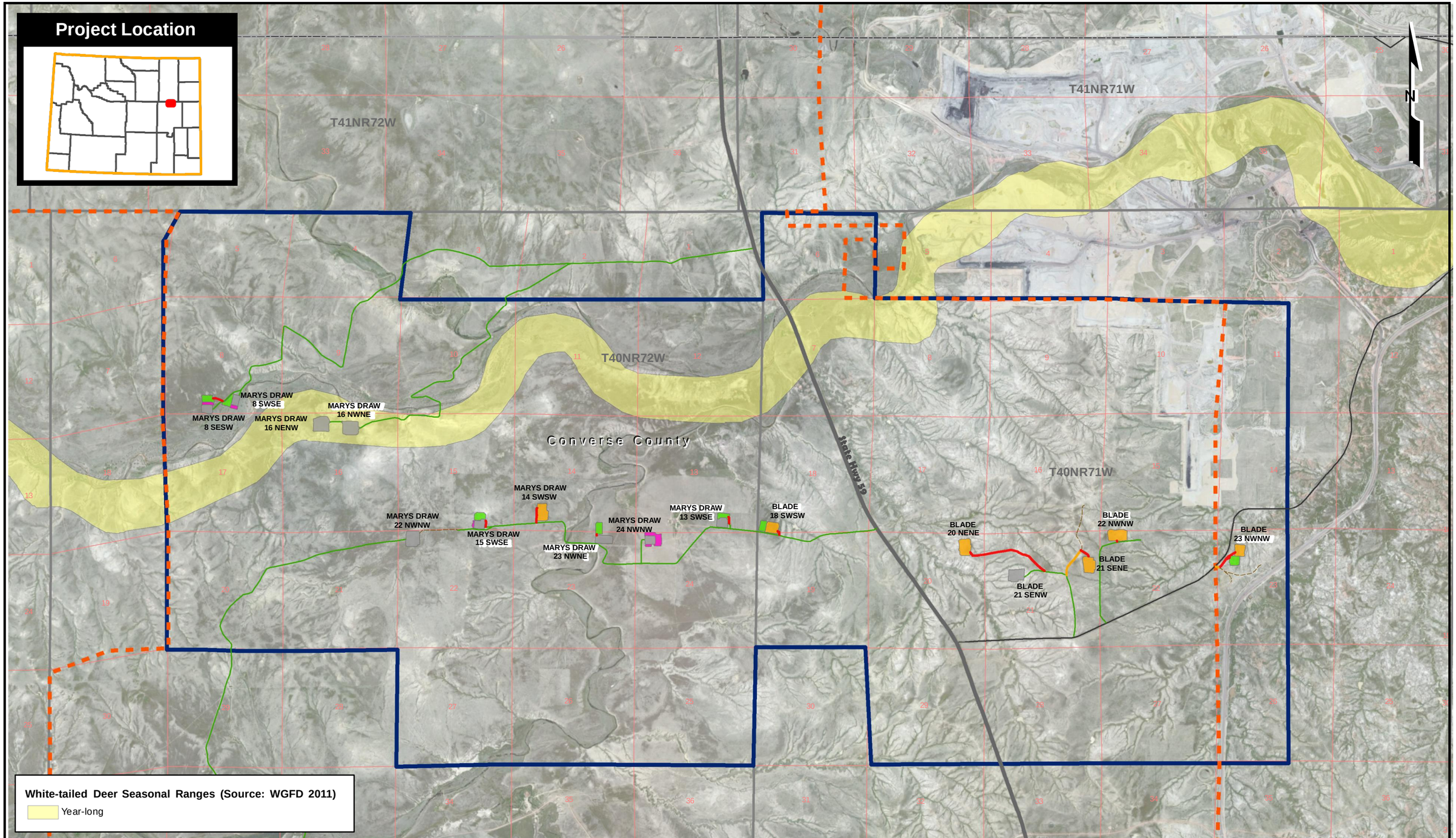

0 0.25 0.5 1 Miles

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DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	3.7.2.4-1_WhitetailedDeerHabitat.mxd

Crossbow 2016 Interim Drilling EA
White-tailed Deer Seasonal Habitat

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.7.2.4-1

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3.7.4 Raptors

Twenty-five raptor species are known residents to the habitat within or in the regional vicinity of the Project Area. Of these 25 species, 12 have been have been known to breed in or near the Project Area and 13 are considered transient species that occupy the Project Area for foraging or during migration periods. **Table 3.7.4-1** identifies all 25 raptor species and their known breeding potential within or near the Project Area. Additionally, raptor nest surveys were completed for all areas within 0.5 miles of the Project Area (one mile for bald eagles [*Haliaeetus leucocephalus*]) in spring and summer of 2015; the numbers of nests for each species identified within the survey area are included in **Table 3.7.4-1**. Nine of the nests observed during the 2015 raptor surveys were indeterminate of species.

Table 3.7.4-1. Occurrence Potential and Surveyed Nest Sites in the Project Area

Common Name	Scientific Name	WGFD Status[1,2]	Surveyed Nest Sites (2015)
American kestrel	*Falco sparverius*	B	2
Bald eagle	*Haliaeetus leucocephalus*	B	--
Barn owl	*Tyto alba*	O	--
Cooper's hawk	*Accipiter cooperii*	O	--
Ferruginous hawk	*Buteo regalis*	B	66
Golden eagle	*Aquila chrysaetos*	B	12
Great horned owl	*Bubo virginianus*	B	--
Gyrfalcon	*Falco rusticolus*	O	--
Long-eared owl	*Asio otus*	B	--
Merlin	*Falco columbarius*	B	--
Northern goshawk	*Accipiter gentilis*	O	--
Northern harrier	*Circus cyaneus*	B	--
Northern pygmy owl	*Glaucidium gnoma*	O	--
Northern saw-whet owl	*Aegolius acadicus*	O	--
Osprey	*Pandion haliaetus*	O	--
Peregrine falcon	*Falco peregrinus*	O	--
Prairie falcon	*Falco mexicanus*	B	--
Red-tailed hawk	*Buteo jamaicensis*	B	10
Rough-legged hawk	*Buteo lagopus*	O	--
Sharp-shinned hawk	*Accipiter striatus*	O	--
Short-eared owl	*Asio flammeus*	B	--
Snowy owl	*Bubo scandiacus*	O	--
Swainson's hawk	*Buteo swainsoni*	B	--
Turkey vulture	*Cathartes aura*	O	--
Western burrowing owl	*Athene cunicularia*	B	--

[1] Occurrence potentials are assigned by the WGFD by latilong or degree blocks. The Project area falls within Block 13, which is bounded by 43 degree (°) and 44° latitude and 105° and 106° longitudes. The recorded breeding and occurrence observations are relevant to the larger latilong block area and do not denote observations of the species within the Project Area.

[2] Occurrence potential values include: nest or young dependent upon parent birds was observed (B); and this species was observed with no evidence of nesting (O).

Source: Orabona et al. 2012; HWA 2015c; BLM 2007a

Raptor species may occupy a variety of habitats depending specific species life history and the time of year. Trees along the Antelope Creek riparian corridor provide habitat for tree-nesting species and could serve as roosting sites. Shrubland and grassland areas may be used by ground nesting species and could serve as foraging areas.

All raptor species and their nests are protected from take or disturbance under the MBTA (16 USC, § 703 et seq.). The golden eagle and bald eagle also receive additional protection under the BGEPA (16 USC, § 669 et seq.).

3.7.5 Migratory Birds

Migratory birds are protected under the MBTA and Executive Order (EO) 13186 (66 Federal Register 3853). EO 13186 designates responsibility to federal agencies to implement the provisions of the MBTA by integrating bird conservation principles and practices into agency activities and to evaluate the impacts of agency actions and plans on migratory birds. Neotropical migrant management direction for the BLM is identified in the BLM Strategic Plan for Migratory Bird Conservation (BLM 2013b).

A list of Birds of Conservation Concern (BCC) was developed by the USFWS as a result of a 1988 amendment to the Fish and Wildlife Conservation Act. This act mandated that the USFWS, "Identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA," (USFWS 2008). The goal of the BCC list is to prevent or, if listed, remove the need for specific migratory bird species to be listed under the ESA by implementing proactive management actions and conservation measures under the guidance of EO 13186. Additionally, the Wyoming Partners in Flight Wyoming Bird Conservation Plan identifies priority bird species and habitats, as well as population and habitat objectives for birds (Nicholoff 2003).

No Wyoming Bird Conservation Habitat Areas are identified within the Project Area (IWJV 2007). Migratory bird species that are listed as BLM Wyoming Sensitive Species and/or USFS Region 2 Sensitive Species are discussed in detail in **Section 3.7.6.2**.

3.7.6 Special Status Species

Special status fish and wildlife are those listed as federally threatened or endangered under the ESA, federal candidate species, species proposed for federal listing as threatened or endangered under the ESA, BLM Wyoming Sensitive Species, and USFS Region 2 Sensitive Species. The ESA provides protection to federally listed, threatened and endangered species from any action that may jeopardize their existence. Section 7 (a)(2) of the ESA (16 U.S.C. Section 1536) mandates federal agencies ensure that any action authorized, funded, or implemented by the agency does not jeopardize the continued existence of any species listed or result in the destruction or adverse modification of critical habitat of such species. Additionally BLM Sensitive Species and USFS Region 2 Sensitive Species are managed under the BLM Manual 6840—Special Status Species Policy and the Forest Service Manual (FSM) 2672.41.

The USFS has also designated Management Indicator Species (MIS) for the TBNG. The Project Area, which is part of the Hilight Bill Geographical Area in the TBNG Land and Resource Management Plan (LRMP), has only the greater sage-grouse designated as an MIS for the "Sagebrush with Tall, Dense and Diverse Understories" biological community (USFS 2001).

Of the 104 special status species identified within Wyoming, 81 were removed from detailed analysis due to the Project Area falling outside of their known range or not containing the appropriate habitat characteristics. The remaining 23 species with the potential to occur in the Project Area were brought forth for detailed analysis. Rationale for the inclusion or removal of species from detailed analysis is provided in Appendix C.

3.7.6.1 Federally Threatened, Endangered, and Candidate Species

3.7.6.1.1 Greater Sage-Grouse

The greater sage-grouse is a sagebrush obligate species and relies on tall stands of sagebrush to provide food and cover (Connelly et al. 2000; Connelly et al. 2004). Quality habitat is characteristic of sagebrush stands with 15 to 25 percent canopy cover and a tall, dense understory of native forbs and grasses. Nesting habitat in Wyoming is sagebrush stands with 20 to 40 percent total canopy cover (USFS 2001). Mating occurs at communal strutting grounds, also known as leks, in patched open areas within sagebrush habitat. During mating, males perform elaborate mating displays at lek locations as a selection process. One male can mate with one or multiple females in a season (Connelly et al 2004). Nesting sites typically occur 2 to 3 miles of a lek location within sagebrush habitat. Brooding typically occurs in areas with 10 to 30 percent total sagebrush cover near grassland openings and meadows. Wintering habitat contains up to 40 percent sagebrush canopy cover and sagebrush taller than 12 inches, and may overlap with nesting habitat (USFS 2001). The BLM has mapped approximately 12,226 acres of sagebrush habitat within the Project Area (**Figure 3.7.6.1-1**).

As a state managed species, the greater sage-grouse is managed by the WGFD. The state currently manages sage-grouse under the Sage-Grouse Executive Order (SGEO) 2011-5, also known as the Sage-Grouse Core Area Protection Program. SGEO 2011-5 identifies conservation measures and environmental review processes for oil and gas activities within Sage-Grouse Core Population Areas (Core Areas) and for lek locations located on state and private lands. The conservation measures for sage-grouse listed under SGEO 2011-5 include setbacks, noise limitations, and seasonal restrictions for development within and outside of Core Areas. No Core Areas are within the Project Area.

The BLM and USFS have recently adopted the Wyoming Resource Management Plan Amendment for Greater Sage-Grouse (BLM 2015). This plan assigns potential habitat for the greater sage-grouse into two major management categories, Priority Habitat Management areas (PHMA) and General Habitat Management Areas (GHMA). All lands within the Project Area are designated as GHMAs. The BLM CFO has also implemented several development restrictions for fluid mineral development within GHMAs, which include:

- Avoid surface disturbance or occupancy within 0.25 miles of the perimeter of occupied sage-grouse leks (Management Action MD SSS 6).
- Surface disturbing and/or disruptive activities would be prohibited from March 15 to June 30 to protect sage-grouse nesting and early brood rearing habitats within 2 miles of the lek or lek perimeter of any occupied lek located outside PHMAs (Management Action MD SSS 9) (BLM 2015).

As no known leks occur within two miles of the Project Area, these mitigation measures are not likely to be applicable to the proposed project (BLM 2015).

The State Wildlife Agencies' Ad Hoc Committee for Consideration of Oil and Gas Development Effects to Nesting Habitat (2008) cites that greater sage-grouse are sensitive to oil and gas disturbance within four miles of lek locations. WGFD lek data identifies one greater sage-grouse lek, named "Steckley Road", within four miles of the Project Area. The lek was observed as active in 2014 (WGFD 2014d). Information on this lek and its current location relative to existing oil and gas development is provided in **Table 3.7.6.1.1-1**. There are 441 existing and approved wells (Wyoming Oil and Gas Conservation Commission [WOGCC] 2015) within a 4-mile buffer of the Project Area, which has a density of approximately 2.2 wells per square mile (based on a 202 square mile area). Currently, there is approximately 1 existing and approved well within 4 miles of the lek (WGFD 2014d; WOGCC 2015a).

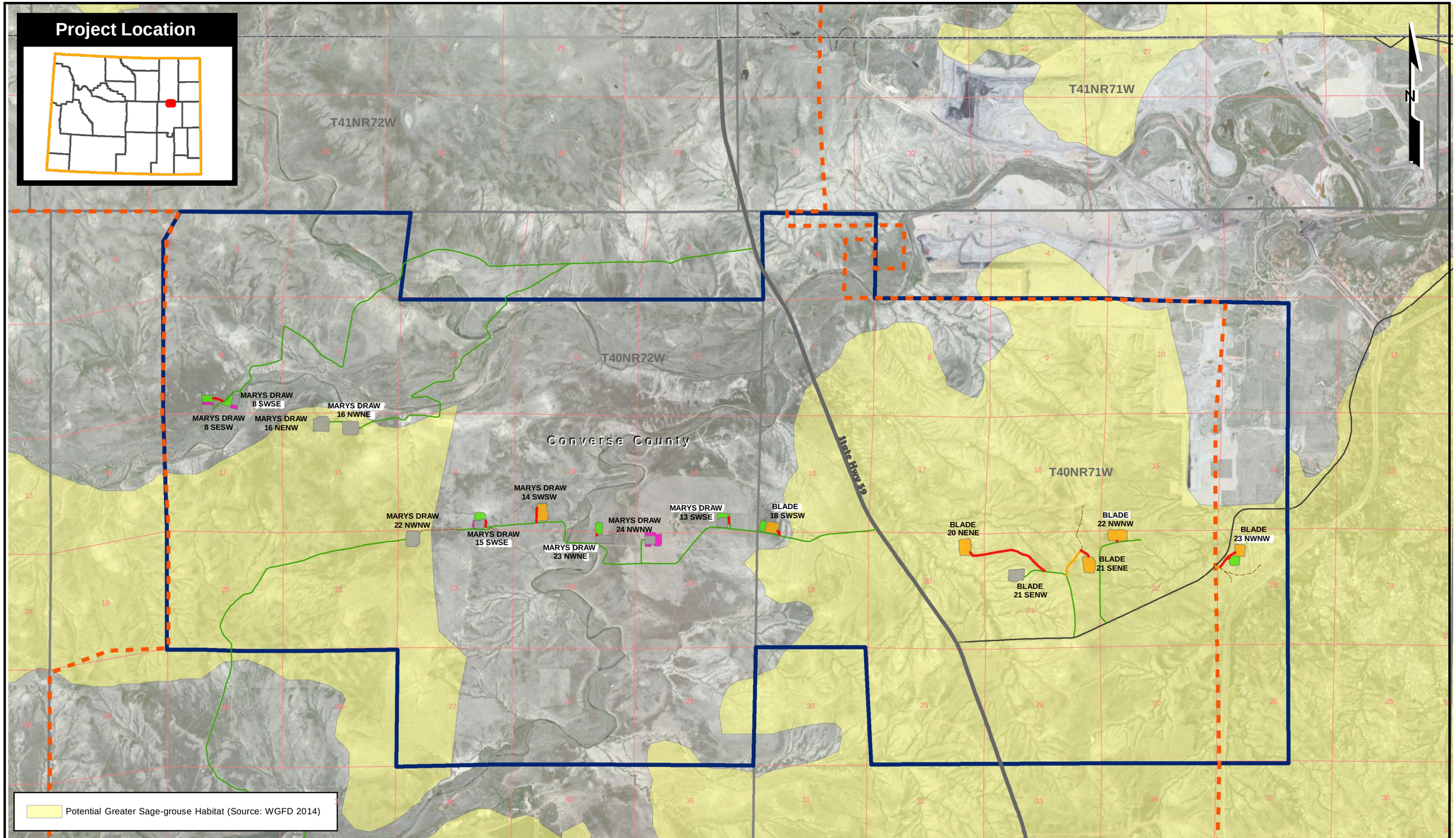
In its *Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats* (WGFD 2010b), WGFD categorized impacts to GSG by number of well pad locations per square mile within two miles of a lek and within identified nesting/brood-rearing habitats greater than two miles from a lek. Moderate impacts occur when well density is between one and two well pad locations per square mile or where there is less than 20 acres of disturbance per square mile. High impacts occur when well density is between two and three well pad locations per square mile or when there are between 20 and 60 acres of disturbance per square mile. Extreme impacts occur when well density exceeds three well pad locations per square mile or when there are greater than 60 acres of disturbance per square mile (WGFD 2010b). The WGFD-defined category of impact for the one existing lek within four miles of the Project Area is provided in **Table 3.7.6.1.1-1.**

Table 3.7.6.1.1-1. WGFD Category of Impact for Greater Sage-Grouse Leks in the 4-Mile Buffer of the Project Area

Lek Name[1]	Distance to Project (miles)	Number of Permitted and Producing Wells[1]		Density of Permitted Producing Wells (wells per square mile)[2]		WGFD Category of Impact[2]
		2-mile buffer	*4-mile buffer*	*2-mile buffer*	*4-mile buffer*	
Steckley Road	2.8	0	1	0.0	0.8	--

[1] Lek locations obtained from WGFD 2014a. The locations of permitted and producing oil and gas wells were obtained from the WOGCC online database (WOGCC 2015a).
[2] Calculations are based off of existing well data and not well pad data as well pad data for the Project Area was not available. If any of the wells located within the 2-mile buffer of an active lek are co-located, then the density of well pads in the 2-mile buffer would be expected to decrease.

The greater sage-grouse population in northeastern Wyoming has exhibited a 10-year cycle of increasing and decreasing populations, with each subsequent peak in population declining over the previous peak. As shown in **Figure 3.7.6.1-2**, a best fit trend line for the males identified during lek counts has been in decline since 1967 (Personal Communication with Scott Jawors, 12/30/14). The Northeast Wyoming Sage-Grouse Working Group (2014) has attributed declines within the region to the cyclical nature of the population in combination with large-scale changes in temperature, precipitation cycles, fire, predation, and energy development have contributed to declines in sage-grouse populations (Dzialak et al. 2011).



0 0.25 0.5 1 Miles

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FILE NAME:	3.7.6.1-1_PotentialGSGHabitat.mxd

Crossbow 2016 Interim Drilling EA
Potential Greater Sage-grouse Habitat

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FIGURE
3.7.6.1-1

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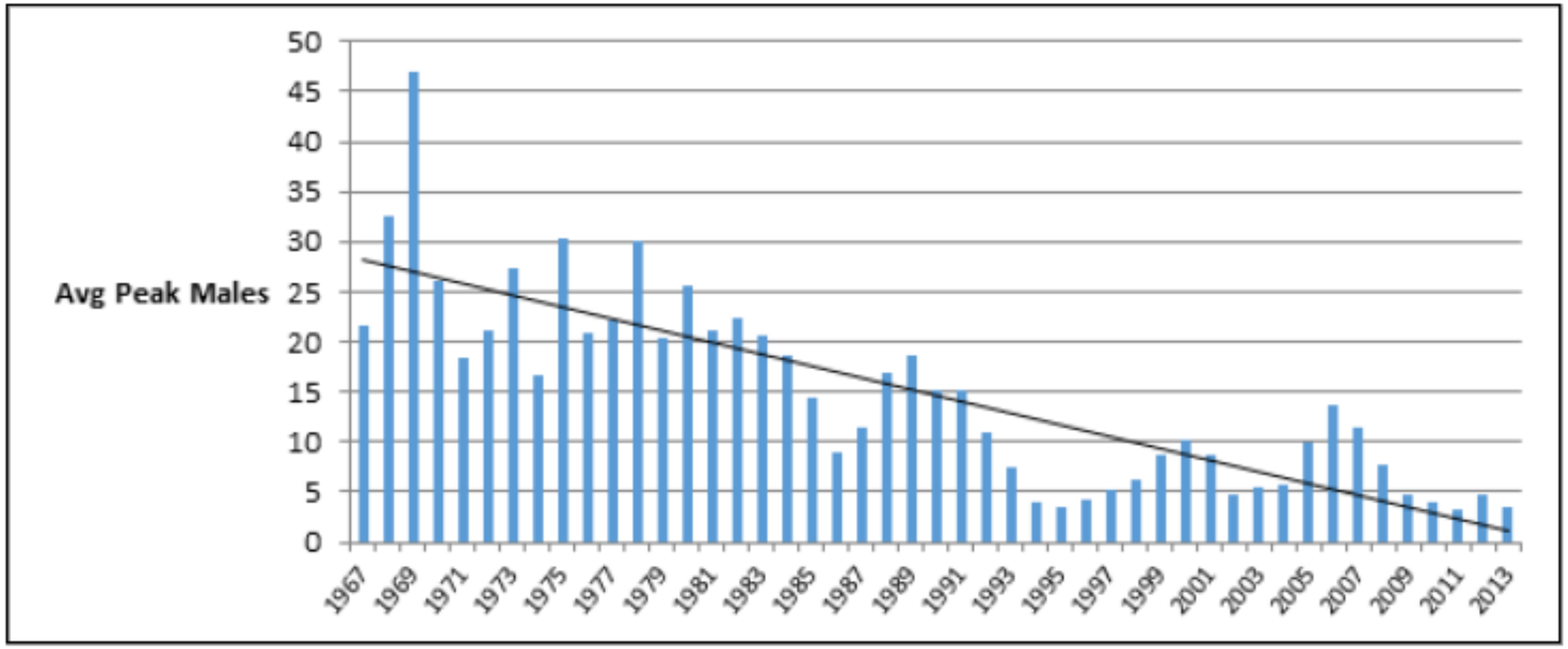

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DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	3.7.6.1-2_AvgNumGSGMales.mxd

Crossbow 2016 Interim Drilling EA
Average Peak Number of Greater Sage-grouse Males

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.7.6.1-2

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Taylor et al. (2012) found that impacts from oil and gas development can be discernible at the spatial scale of 20 kilometers (12.4 miles). This spatial scale is similar to other studies, in which biologists observed basin-wide population declines (Walker et al. 2007). There are five recorded leks within 12.4 miles of the Project Area, all of which have been active within the last 10 years. Currently there are 1,803 existing and approved wells within 12.4 miles of the Project Area, an area of 864 square miles.

3.7.6.2 BLM and USFS Sensitive Species

3.7.6.2.1 Black-tailed Prairie Dog

The black-tailed prairie dog is a BLM Wyoming and USFS Region 2 Sensitive Species. Black-tailed prairie dogs inhabit short- and mixed-grass prairies with fine, sandy soils (Koford 1958; Clippinger 1989). Lands with slopes greater than 20 degrees are considered suitable habitat for this species (Clippinger 1989, Reading and Matchett 1997). Historic and current threats to black-tailed prairie dog populations include intensive eradication programs, agricultural development, sylvatic plague, urbanization, and recreational shooting (Wuerthner 1997; Van Pelt 1999). Based on limited survey data, approximately 38 acres of known black-tailed prairie dog colonies that have been mapped by the WGFD in the eastern portion of the Project Area.

3.7.6.2.2 Northern River Otter

The northern river otter (*Lontra canadensis*) is a USFS Region 2 Sensitive Species. This species is also listed as a WGFD SGCN and is assigned a conservation rating of Native Species Status (NSS) Unknown (NSSU), indicating that the status for this species is unknown until further information is obtained (WGFD 2010a). Preferred habitat for northern river otters includes lakes, streams, and aquatic habitats with riparian cottonwood, riparian shrub, willow, and marsh-swamp ecological systems (WGFD 2010a; Boyle 2006). This species has a potential to occur along Antelope Creek and its associated riparian corridor.

3.7.6.2.3 Swift Fox

The swift fox (*Vulpes macrotis*) is a BLM Wyoming and a USFS Region 2 Sensitive Species. This species is also listed as a WGFD SGCN and is assigned a conservation rating of NSS4. This rating was assigned to the swift fox as its population status and trends are unknown, but are suspected to be stable; and its habitat is vulnerable, but is not undergoing substantial loss (WGFD 2010a). Habitat for the swift fox is generally considered short- and mixed-grass prairies set in rolling hills; however, in Wyoming, this species has also been observed using sagebrush steppes, with low vegetation, flat terrain, and friable soils (Kahn et al. 1997; Olson and Lindzey 2002; WGFD 2010a). The swift fox may occupy the sagebrush and prairie habitats found within the Project Area. While surveys for this species have not been completed within the Project Area, this species has been observed opportunistically (HWA 2015c)

3.7.6.2.4 Golden Eagle

The golden eagle is not listed as a sensitive species by the USFS, BLM, USFWS, or WGFD; however, it is a federally protected species under the BGEPA. The *Wyoming Bird Conservation Plan* (WBCP) rates it as a Level I species, indicating it is a species of local interest. In Wyoming, this species is considered a common year-round resident. The golden eagle is also listed by the USFWS as a BCC for Region 17. Golden eagles occur throughout the mountain and grassland regions in open areas where abundant prey (e.g. small mammals and rabbits) bases exist. Nesting typically occurs in trees and cliffs (Orabona et al. 2012; BLM 2013a). Surveys completed in the 2015 nesting season identified 12 golden eagle nests within

0.5 miles of the Project Area, four of which are within 0.5 miles of proposed disturbance. None of these nests were active in 2015 (HWA 2015c).

3.7.6.2.5 Western Burrowing Owl

The western burrowing owl is a BLM Wyoming and USFS Region 2 Sensitive Species. This species is also listed as a WGFD SGCN and is assigned a conservation rating of NSS4. This designation is based on the knowledge that the western burrowing owl is widely distributed; its population status and trends are unknown, but are suspected to be stable; habitat is restricted or vulnerable; and it may be sensitive to human disturbance (WGFD 2010a). The WBCP rates it as a Level I species, indicating it is in need of conservation action. The western burrowing owl is also listed by the USFWS as a BCC for Region 17.

The western burrowing owl is a ground nesting species that utilizes burrows for nest construction (Orabona et al. 2012). The western burrowing owl does not often excavate its own borrow, but relies heavily on burrowing mammal species to provide nesting habitat (Thomsen 1971). Habitat for this species is a combination of the following components:

- open, dry, treeless areas on grasslands, shrublands, and desert floors;
- gentle slopes, short vegetation, and high percentages of bare ground;
- high densities of burrows (e.g. prairie dog colonies);
- current activity of burrowing mammals, primarily prairie dogs;
- close proximity to other nesting burrowing owls; and
- dried manure from cows, horses, or bison (Lantz et al. 2004).

No burrowing owl nests have been observed within the Project Area. Approximately 38 acres of black-tailed prairie dog colonies are mapped by the WGFD within the Project Area; which may serve as potential nesting habitat for western burrowing owls.

3.7.6.2.6 Ferruginous Hawks

The ferruginous hawk is a BLM Wyoming and USFS Region 2 Sensitive Species. The ferruginous hawk is also a WGFD SGCN and is assigned a conservation rating of NSS3, as the species is widely distributed; its population status and trends are unknown, but are suspected to be stable; they are experiencing ongoing loss of habitat; and they are sensitive to human disturbance (WGFD 2010a). The WBCP rates the ferruginous hawks as a Level I species, indicating they are in need of conservation action. The ferruginous hawk is also listed by USFWS as a BCC for Region 17.

The ferruginous hawk inhabits semi-arid and open grasslands, basin-prairie shrublands, and badlands. It prefers large tracts of relatively undisturbed rangelands. Nesting occurs on rock outcrops, the ground, cutbanks, cliffs, or trees (WGFD 2010a). Surveys completed in the 2015 nesting season identified 66 ferruginous hawk nests within 0.5 miles of the Project Area. Eleven ferruginous hawk nests are within 0.5 miles of disturbance; two of these nests were active in 2015 (HWA 2015c).

3.7.6.2.7 Bald Eagle

The bald eagle is a BLM Wyoming and USFS Region 2 Sensitive Species. Successful, nationwide recovery efforts resulted in the delisting of the bald eagle as a threatened species under the ESA on August 8, 2007. As a result, the species only receives federal protection under the MBTA and the BGEPA (USFWS 2007).

The bald eagle is also listed in Wyoming as a WGFD SGCN, with a NSS2 conservation rating. This is due to populations being restricted in numbers and distribution, the ongoing loss of habitat, and their sensitivity to human disturbance (WGFD 2010a). The WBCP rates the species as a Level I species, indicating they are in need of conservation action. The bald eagle is also a USFWS BCC for Region 17.

Nesting habitat for bald eagles occurs in the crowns of large cottonwood trees (Orabona et al. 2012). The presence of food sources, which consists of fish and waterfowl, strongly dictate the distribution of bald eagles within Wyoming. Carrion and rodents can also serve as opportunistic food sources when fish and waterfowl are restricted or seasonally unavailable (Ehrlich et al. 1988). No nesting locations have been observed within the Project Area.

During the winter, bald eagles use mature trees along open water in Wyoming for foraging and roosting habitats (WGFD 2010a). Winter roosting habitat can also occur in terrestrial areas where upland prey sources are available. No winter bald eagle roosting habitat was identified within the Project Area; however, during winter raptor surveys, 34 bald eagles were sighted within one mile of the Project Area (HWA 2015c).

3.7.6.2.8 Loggerhead Shrike

The loggerhead shrike (*Lanius ludovicianus*) is listed as both a BLM Wyoming and USFS Region 2 Sensitive Species. The WBCP rates the loggerhead shrike as a Level II species, indicating they are in need of monitoring. The loggerhead shrike is also listed by USFWS as a BCC for Region 17. As a summer resident in Wyoming, this species breeds in scattered trees and large shrubs, often in low lying areas (Wiggins 2005). Nests are found in tree branches or in the crown of shrubs (Orabona et al 2012). An important feature of breeding is dense shrub and tree canopy located nearby open foraging areas (Wiggins 2005). The need for open habitat adjacent to densely vegetated breeding habitat demonstrates that the mosaic landscapes found in Wyoming are an important habitat for the species (Keinath and Schneider 2005). This species has the potential to occur throughout the Project Area in transitional habitats with shrub and tree cover.

3.7.6.2.9 Lewis's Woodpecker

Lewis's woodpecker (*Melanerpes lewis*) is a USFS Region 2 Sensitive Species. The Lewis's woodpecker is also a WGFD SGCN with a conservation rating of NSSU. NSSU indicates that the status for this species is unknown until further information is obtained (WGFD 2010a). The WBCP rates the Lewis's woodpecker as a Level II species, indicating they are in need of monitoring. The Lewis's woodpecker is also listed by the USFWS as a BCC for Region 17. This species is an uncommon summer resident in Wyoming (Orabona et al. 2012) and typically inhabits open country with scattered trees. Nesting occurs in burned out Douglas-fir (*Pseudotsuga menziesii*), mixed conifer, juniper (*Juniperus spp.*), and riparian and oak woodland, but is also found in deciduous forests (WGFD 2010a). Nests are generally excavated cavities in live trees, dead trees, or wooden poles (WGFD 2010a). This species has the potential to occur throughout the Project Area and utilize the Antelope Creek riparian corridor for nesting habitat.

3.7.6.2.10 BLM and USFS Sagebrush Bird Species

Three sagebrush obligate bird species listed by both the BLM and the USFS Region 2 as sensitive species are known to occur within the Project Area. Due to their similarity in habitat requirements and life history, these species will be discussed together in this EA. These species, their protected status, and their habitat

descriptions are provided in **Table 3.7.6.2.10-1** below. The BLM has identified approximately 12,226 acres of sagebrush habitat within the Project Area.

Table 3.7.6.2.10-1. BLM and USFS Sagebrush Bird Species within the Project Area

Species Name	USFS Region 2 Sensitive Species	BLM Sensitive Species	WGFD SGCN Status	Habitat Description
Sage Sparrow *Amphispiza belli*	Yes	Yes	NSS3	As a sagebrush obligate species, sage sparrows rely on large swaths of tall, dense sagebrush. Sage sparrows prefer nesting in the interior of sagebrush habitats, and generally avoid fringe areas around sagebrush patches (Hansley and Beauvais 2004a; Bolger et al. 1997). This species a common summer resident within Wyoming (Orabona et al. 2012).
Sage Thrasher	Yes	Yes	NSS4	Sage thrashers are a sagebrush obligate species (Buseck et al. 2004; WGFD 2010a). Preferred habitat is dense patches of sagebrush with relatively low grass cover. Nests are typically constructed on the ground beneath sagebrush shrubs (WGFD 2010a). This species a common summer resident within Wyoming (Orabona et al. 2012).
Brewer's Sparrow *Spizella brewerii*	Yes	Yes	NSS4	This species is considered a sagebrush obligate species (Hansley and Beauvais 2004b; WGFD 2010a); though it may use mountain mahogany, rabbitbrush (*Asteraceae spp.*), pinyon-juniper, or bunchgrass grassland habitat types. Habitat is positively correlated with shrub cover, above-average vegetation height, and horizontal habitat heterogeneity (WGFD 2010a). This species a common summer resident within Wyoming (Orabona et al. 2012).

* All species included are WBPC Level I species and are USFWS Region 17 BCC

3.7.6.2.11 BLM and USFS Grassland Bird Species

Six grassland migratory bird species that are listed as BLM and the USFS Region 2 as sensitive species have been identified as potentially occurring within the Project Area. These species, their conservation status, and their habitat descriptions are provided in **Table 3.7.6.2.11-1**. Due to their similarity in habitat requirements within the Project Area and their seasonal presence within Wyoming, these species will be discussed as a single complex.

3.7.6.2.12 Northern Leopard Frog

The northern leopard frog (*Lithobates pipiens*) is a BLM Wyoming and USFS Region 2 Sensitive Species. The northern leopard frog is also a WGFD SGCN, with a conservation rating of NSSU as its status is unknown until further information is obtained. This species generally inhabits areas within or near permanent water in the plains, foothills, and montane zones (WGFD 2010a; Smith and Keinath 2007). Preferred habitats within Wyoming are found in swampy cattail marshes on the plains and beaver ponds in foothills and montane zones (WGFD 2010a). This species may use riparian areas along the Antelope Creek riparian corridor.

Table 3.7.6.2.11-1. BLM and USFS Grassland Bird Species within the Project Area

Species Name	USFS Region 2 Sensitive Species	BLM Sensitive Species	WGFD SGCN Status	Habitat Description
Baird's sparrow[1] *Ammodramus bairdii*	Yes	Yes	NSS3	Spring, summer, and fall foraging and breeding habitat is found in short-grass eastern Great Plains grasslands. Nests occur in natural, scratched depressions in the ground (Orabona et al. 2012). This species a common summer resident within Wyoming (Orabona et al. 2012).
Grasshopper Sparrow *Ammodramus savannarum*	Yes	--	NSS4	Inhabits short-grass prairies, mixed grasslands, wet moist meadows, open sagebrush-grasslands, and agricultural areas (WGFD 2010a; Orabona et al. 2012). Herbaceous cover and conspicuous perches are required for habitat; as such, habitats with greater than 35 percent cover are generally avoided (WGFD 2010a). Grasshopper sparrows are uncommon summer residents in Wyoming (Orabona et al. 2012).
McCown's longspur[1] *Calcarius mccownii*	Yes	--	NSS4	Inhabits open, dry, and sparsely vegetated areas in short-grass prairies and basin-prairie shrublands. Plowed or grazed fields and dry lakebeds are also considered habitat. Areas with a balance of 45 to 80 percent grass cover and 15 to 25 percent bare ground are considered preferred habitat (WGFD 2010a). This species a common summer resident within Wyoming (Orabona et al. 2012).
Chestnut-collared longspur *Calcarius ornatus*	Yes	--	NSS4	Habitat is found in short-grass and open mixed-grass prairies. Mesic areas such as low, moist areas and wet-meadow zones around wetlands may provide suitable habitat for this species (WGFD 2010a). This species an uncommon summer resident within Wyoming (Orabona et al. 2012).
Mountain plover *Charadrius montanus*	Yes	Yes	--	Mountain plovers are generally associated with disturbed habitats for nesting. Habitat within this species nesting range includes native short- and mixed-grass prairies; semi-desert sites; prairie-dog colonies; and agricultural lands (Dinsmore 2003). Field reconnaissance surveys have identified approximately 143 acres of potential mountain plover habitat within the Project Area. This species a common summer resident within Wyoming (Orabona et al. 2012).
Long-billed curlew[1] *Numenius Americanus*	Yes	Yes	NSS4	Inhabits many grassland types including moist meadow grasslands, agricultural areas, and dry prairie uplands. habitat needs to be within proximity to surface water sources. Preferred habitat includes a complex of short-grass prairies, agricultural fields, wet and dry meadows and prairies, and grazed mixed-grass and scrub communities (WGFD 2010a). This species is an uncommon summer resident within Wyoming (Orabona et al. 2012).

* All species with exception to the Mountain Plover are USFWS Region 17 BCC

[1] WBPC Level I species

3.7.6.2.13 USFS Region 2 Sensitive Fish Species

As discussed in **Section 3.4 – Water Resources**, the entirety of the Project Area falls within the Antelope Creek drainage basin, which is a tributary to the Cheyenne River. While no special status fish species are known to inhabit Antelope Creek, four fish species have been found within the Cheyenne River system,

which begins 14 miles east of the Project Area. All four species are designated as USFS Region 2 Sensitive Species. Habitats for each species as well as their WGFD conservation rating are provided below in **Table 3.7.6.2.13-1**.

Table 3.7.6.2.13-1. USFS Region 2 Sensitive Fish Species in the Cheyenne River System

Species Name	USFS Region 2 Sensitive Species	WGFD SGCN Status	Habitat Description
Mountain sucker *Catostomus platyrhynchus*	Yes	--	Inhabits lotic waters within a wide variety of water body types from small montane streams to large rivers, and has the potential to occur in smaller alpine lakes in Wyoming. Within streams mountain sucker are commonly found in low-gradient segments that consist of a mix of riffles, pools, and runs (Belica and Nibbelink 2006; Baxter and Stone 1995).
Plains Topminnow *Fundulus sciadicus*	Yes	NSS3	Inhabits shallow, slow water in clear streams with heavy vegetation and sand or gravel substrates (Baxter and Stone 1995; Rahel and Thel 2004a). May also inhabit vegetation-filled sloughs and backwaters (Baxter and Stone 1995).
Plains minnow *Hybognathus placitus*	Yes	NSS3	Found in large, turbid, prairie streams and rivers with slow water and side pools (Baxter and Stone 2005; WGFD 2010a).
Flathead chub *Platygobio gracilis*	Yes	NSS4	Inhabits turbid streams with small substrate (Baxter and Stone 1995; Rahel and Thel 2004b).

3.8 CULTURAL RESOURCES

This section is organized to address a definition of cultural resources and a summary of existing, known cultural resources within the Project Area. Additional, detailed information relating to the historic and prehistoric contexts of the Project Area are presented in the cultural resources reports prepared for this EA (SWCA 2015).

3.8.1 Introduction

Cultural resources are remnants of past human activity that are typically at least 50 years old (Little et al. 2000). Cultural resources can be divided into “prehistoric” (pre-contact with Europeans), “historic” (post-contact Native American and European), or both (multi component), and can be considered historic or archaeological resources. Sites are the locations of a significant event, a prehistoric or historic occupation or activity, or a building or structure (Andrus and Shrimpton 2002). Buildings are primarily constructions used to shelter any form of human activity (such as a courthouse, barn, or house), while structures are functional constructions made for other purposes (such as a bridge, trolley car, or canal). Objects include other items that are not classified as buildings or structures, such as a monument or boundary marker.

Cultural resources can also include Traditional Cultural Properties (TCPs), which are locations with enduring significance to the beliefs, customs, and/or practices of living communities (Parker and King 1990). In particular, a TCP is a place defined by its historical association with the beliefs, customs, and/or practices of an existing community and its continuing, contemporary importance in maintaining that

community's cultural identity. Cultural resources are non-renewable, can provide a record of prehistoric and historical cultures and events, and have value for many contemporary groups.

3.8.2 Regulatory Background

Federal historic preservation legislation provides a legal environment for documentation, evaluation, and protection of cultural resources that may be affected by federal undertakings, or by private undertakings operating under federal license, with federal funding, or on federally managed lands. These include the NHPA; Archaeological and Historic Preservation Act (AHPA) of 1974; FLPMA; American Indian Religious Freedom Act of 1978; Archaeological Resource Protection Act (ARPA), as amended; Native American Graves Protection and Repatriation Act of 1990 (NAGPRA); and several EOs. For example, EO 11593 provides guidance for federal agencies on protection and enhancement of cultural resources, and EO 13175 encourages consultation and communication between federal agencies and tribal officials.

Cultural resources that are deemed significant for their contribution to broad patterns of history, prehistory, architecture, engineering, and culture are eligible for listing on the National Register of Historic Places (NRHP), and require specific considerations under the NHPA. In order to be eligible for inclusion on the NRHP, a cultural resource must be significant under one or more of the four evaluation criteria:

- **Criterion A:** Associated with events that have made a significant contribution to the broad patterns of our history; or
- **Criterion B:** Associated with the lives of persons significant in our past; or
- **Criterion C:** Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- **Criterion D:** Yielded, or may be likely to yield, information important in prehistory or history.

In addition, a resource must be able to convey its significance through the retention of specific aspects of integrity, such as location, design, setting, materials, workmanship, feeling, and association. TCPs are generally considered eligible for nomination to the NRHP if they are associated with cultural practices or beliefs of a living community that are (a) rooted in the community's history and (b) important in maintaining the continuing cultural identity of the community (Parker and King 1990). Once a cultural resource is evaluated, if it is found to be significant it is then called a historic property under Section 106 of the NHPA.

Since BLM is the lead agency for this proposed project, the BLM manuals for cultural resources, National Programmatic Agreement (BLM 1997), State Protocol (BLM and State Historic Preservation Officer [SHPO] 2014), and CFO RMP (BLM 2007a) are also applicable. The BLM has seven manuals that provide policies and guidance for the management of cultural resources: MS-8100 through MS-8170 (BLM 2004b-h). The BLM, Advisory Council on Historic Preservation, and National Conference of State Historic Preservation Officers developed a National Programmatic Agreement (and subsequent amendments) regarding how BLM will meet its responsibilities under NHPA. In 2014, the Wyoming SHPO and BLM developed a State Protocol that supplements the National Programmatic Agreement by outlining a streamlined consultation process between the Wyoming BLM and SHPO. The goal of the National Programmatic Agreement and State Protocol is to forge a more meaningful and productive historic

preservation partnership between the BLM and SHPO that will enhance the management of historic properties under the BLM's jurisdiction.

The CFO ROD and Approved RMP addresses goals, objectives, and management actions related to cultural resources. Some of these goals and objectives include preserving and protecting cultural resources, reducing threats from natural or human-caused deterioration, developing treatment plans, and maintaining consultation with Native Americans. The management actions that the BLM will enact to achieve these goals and objectives include inventorying cultural resources, developing public outreach efforts, and protecting cultural resources.

3.8.3 Affected Environment

A Class III cultural resource inventory was conducted for the proposed project and included a file search and field survey (SWCA 2015). The file search of previously conducted projects and recorded sites within one mile of the Project Area was conducted at the Wyoming SHPO office and online at the Wyoming Cultural Records Office online database for Public Land Survey System and BLM database of General Land Office records. A total of 56 previous inventories were conducted in the file search area and these inventories identified 48 cultural resource sites, of which 30 are prehistoric, 11 are historic, and seven are multicomponent. Of the 48 cultural resources, eight are eligible for nomination to the NRHP, two are unevaluated, two have unknown eligibilities, and 36 are not eligible. Eight of the 48 sites are located within the Project Area and include one historic cairn, five prehistoric lithic scatters with fire-cracked rock and/or hearths, one historic debris scatter/trash dump, and one historic homestead. The field survey included examining 18 80-acre well pad blocks and a 500-foot-wide survey corridor for access roads and pipelines (SWCA 2015). During this field survey, six of the previously recorded sites were revisited, one new site discovered and recorded, one new site was identified but not recorded outside the Project's area of potential effect, and 13 new isolated resources were documented.

Based on the file search and field survey results, the Class III cultural resource inventory determined that five sites within the Project Area are recommended not eligible for nomination to the NRHP. The newly identified site is a large, occupied historic homestead/ranch and the owners requested that their property not be recorded. Isolated resources do not qualify as sites and are therefore not eligible for inclusion on the NRHP. The remaining site (48CO3077) within the Project Area has been determined eligible to the NRHP.

3.9 LIVESTOCK AND GRAZING

3.9.1 Regulatory Background

The State of Wyoming has created Conservation Districts covering the state. The objectives of these conservation districts is to provide guidance to private landowners on conservation of natural resources and facilitating cooperation between state and federal land managing agencies (Converse County 2003, WYACD 2015). Grazing practices on private lands within the Project Area are guided by the Converse and Campbell County Conservation Districts (WYACD 2015). Private lands comprise approximately 21,099 acres (86 percent) of surface ownership within the Project Area.

A total of 1,857 acres (7.5 percent) of the Project Area consists of lands administered by the State of Wyoming. Livestock grazing on state lands in Wyoming is regulated by the OSLI and is permitted on state

lands within the Project Area. The OSLI manages these lands under direction from the Board of Land Commissioners (BLC).

Approximately 1,449 acres (6.5 percent) of the Project Area are administered by the USFS as the TBNG. The TBNG is managed under the TBNG RMP, which provides guidance for livestock grazing activities within the TBNG (USFS 2001). Specific direction within the RMP:

- Restricts grazing practices that degrade riparian woody draw areas
- Requires changes to grazing practices to adjust to natural processes like wildfire or drought
- Requires that rest objectives for grazing allotments be met
- Prohibits feeding of livestock, prohibits grazing within developed recreational sites
- Prioritizes the removal of fences or water development structures that are not contributing to achieving desired management goals

In addition to the TBNG RMP, there are various laws and regulations set forth by the federal government that govern livestock grazing on the TBNG within the Project Area. These laws are listed in **Table 3.9.1-1.**

Table 3.9.1-1. Public Laws to Guide Range Management and Livestock Grazing on Federal Lands

Public Law	BLM	USFS
Organic Administration Act of 1897		X
The Bankhead-Jones Farm Tenant Act of 1937	X	X
Granger-Thye Act of 1950		X
The Multiple Use Sustained Yield Act of 1960		X
Federal Land Policy and Management Act of 1976	X	X
National Forest Management Act of 1976		X
Forest and Range Renewable Resource Planning Act of 1974		X
Public Rangelands Improvement Act of 1978	X	X

Source: USFS 2001a

3.9.2 Exiting Grazing Uses and Conditions

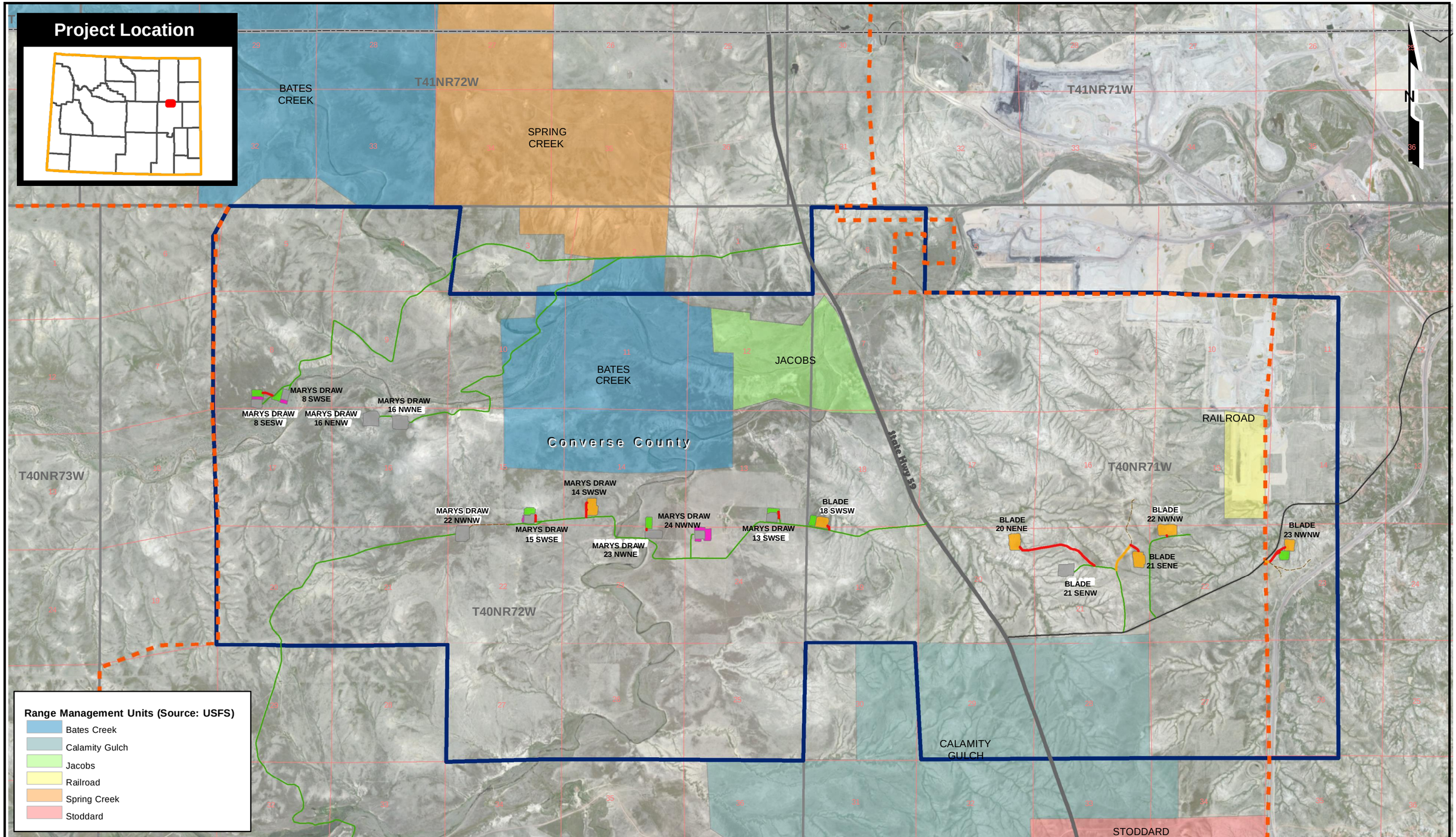
The top produced crop in Converse County in 2012 was corn for silage, also known as green chop (USDA-NASS 2014). This crop is produced to support the production of livestock, the main agricultural commodity in Converse County.

According to the 2012 Census on Agriculture, the top two livestock commodity groups in Converse County were cattle and calves as well as sheep and lambs (USDA-NASS 2014). Additionally, in Converse County in 2012, the value of livestock, poultry, and their products was $42.4 million. (USDA-NASS 2014)

There are currently four grazing allotments within the Project Area. Three of these allotments are managed by the USFS and one allotment is managed by the BLM (**Figure 3.9.2-1**); however, it should be noted that there is no BLM managed surface within the Project Area. **Table 3.9.2-1** provides current grazing allotment information within the Project Area.

Currently non-federal lands within the grazing allotments are not fenced out, meaning the private and state lands are grazed in accordance with the federal grazing permits and any allotment grazing management plans. Winter and spring are the authorized grazing season(s) for all the allotments. The BLM has not assigned a management category for the Bates Creek allotment (BLM 2007a). The USFS has determined that 96 percent of the TBNG is suitable for livestock grazing, thus the lands within the Project Area are determined to be suitable for livestock grazing (USFS 2001).

Currently within the Project Area there is a network of fences and other structures that have been built to better control cattle movement and improve grazing management. Improvements may include fences, cattle guards, weed control, erosion control, prescribed burns, reclaimed areas, springs, water pipelines, reservoirs, water wells, and access roads (BLM 2012c).



0 0.25 0.5 1 Miles

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Legend

- Proposed Well Pad
- Proposed Facilities Pad
- Proposed Pad Expansion
- Existing Well Pad
- Proposed Access Road
- Proposed Road Upgrade
- Highway
- County Road
- Existing Access Road
- Existing Two-track
- Greater Crossbow EIS Project Area
- County Boundary
- Township/Range Boundary
- Section Boundary

Project Area Boundary: EOG (2015)

- 2015 Interim EA Project Area

* Four 3-acre frac pads will be included but are conceptual and not located spatially at this time.

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PROJECT NO.	20154640.001A
DRAWN:	12/16/2015
DRAWN BY:	J. Weber
CHECKED BY:	M. Bridendall
FILE NAME:	3.9.2-1_LivestockGrazing.mxd

Crossbow 2016 Interim Drilling EA
Livestock Grazing Allotments

EOG Resources, Inc.
Converse County, Wyoming

FIGURE
3.9.2-1

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Table 3.9.2-1. Livestock Grazing Allotments within the Project Area

Agency[1]	Allotment Number	Allotment Name	Livestock Class	Status	Total Acres in Allotment	Acres in Project Area	Percent Acres within Project Area	Total Federal AUMs[2] in Allotment	Calculated AUMS in Project Area[3]
BLM	12236	Bates Creek	Cattle	Active	22,490	1,813	8.06	12	5.81
USFS	09287	Calamity Gulch	Sheep/Goats	Active	18,692	1,313	7.02	180	12.6
USFS	09213	Jacobs	Sheep/Goats	Active	10,247	575	5.61	1,333	74.6
USFS	Unknown	Railroad	Unknown	Unknown	204	204	100	10	10

* Approximately 1,441 acres of federal surface managed by the USFS is present within the Project Area.
1 Range management units (i.e., allotments and general resource areas) may include surface land ownership other than USFS (e.g., surface lands owned by the BLM).
2 Animal Unit Month (AUM)
3 Acreage determined using GIS calculations; WY OSLI calculations based on Office of State Lands & Investments - State Lands Access Interactive Map. Assume 20 acres/AUM

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4.0 ENVIRONMENTAL EFFECTS

This chapter provides an analysis of the anticipated direct and indirect environmental impacts to resources from the implementation of the No Action Alternative or the Proposed Action Alternative, as described in **Chapter 2**, *Description of Alternatives*. Direct impacts are those defined as effects caused by the action and occur at the same time and/or place (40 CFR 1508.8). Indirect impacts are effects caused by the action, but occur later in time and/or place. In addition, impacts in this chapter are described as short-term and long-term. Short-term impacts refer to those impacts that would occur within five years of an action, which is the timeframe needed to reclaim a site in Wyoming. Long-term impacts refer to those impacts that would persist for more than five years (e.g., impacts that would remain during the operation of the wells and would last for the life of the project, anticipated to be 15 years). These impact definitions are the same as those used in the CFO RMP.

In this EA, potential impacts were evaluated quantitatively[3] and/or qualitatively for the No Action Alternative and the Proposed Action Alternative, depending on the available data and the nature of the resource analyzed. This impact assessment assumes all ACEPMs described in **Section 2.2.8** for the Proposed Action Alternative would be implemented. Each resource discussion includes mitigation measures that would be implemented to reduce or avoid the effects of the Proposed Action Alternative. Each resource discussion also concludes with a description of residual effects, which are defined as any effects resulting from the Proposed Action Alternative that would remain after implementation of the mitigation measures.

For comparative purposes in this EA, a brief quantitative and/or qualitative assessment of impacts was described for the No Action Alternative. A more in-depth analysis was conducted for the Proposed Action Alternative. It is important to remember that under the No Action Alternative, oil and gas development would occur on a case-by-case basis in the Project Area. As such, impacts to resources could occur as a result of surface-disturbing activities, as well as well construction, drilling, completion, and production activities. The types of impacts that would result from the No Action Alternative would depend on the intensity of the development and would likely be similar to the types of impacts described for the Proposed Action Alternative. This EA assumes impacts under the No Action Alternative would potentially be less intense given the smaller scale of development (i.e., 39 fewer wells) than under the Proposed Action Alternative. For the No Action Alternative, potential impacts would be identified at the time of individual APD submittals, and appropriate COAs would be included in the APDs to mitigate impacts that could result from proposed oil and gas development on fee and state surface estate.

4.1 AIR QUALITY

An air quality emissions inventory has been conducted to analyze emissions that could potentially result from the Proposed Action Alternative and No Action Alternative. This is done through the development of an emissions inventory, which includes project data and key operational variables. Examples include:

[3] As presented in **Table 2.1-2** and **Table 2.2.1.1-1**, total acreage estimates are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies. GIS-based calculations are considered more accurate than estimates calculated using simple addition and therefore are utilized throughout this document, wherever possible.

number of oil and gas wells drilled per year and through the life of the project, potential production rate of the wells, type and size of heaters and engines, and the nature and duration of construction activities.

The following sections discuss the methodology and results of this analysis. For more specific details, refer to **Appendices D** and **E** for the emission calculations, including footnotes on emissions factors, formulas, and other sources used.

4.1.1 No Action Alternative

Under the No Action Alternative, horizontal oil and natural gas development would only occur on state or fee mineral estate, and EOG would only develop eight new wells. Direct and indirect impacts to air quality under the No Action Alternative would yield the same or lesser impacts compared to those described under the Proposed Action Alternative. Under this alternative, EOG would continue to utilize surface lands in the area under current approvals, as other development actions would be considered on a case-by-case basis and go through the appropriate approval processes. Emissions for construction, development, and operations would include the development of eight wells on two new pads and two expanded pads, and thus result in fewer emissions and lower potential for impacts than the Proposed Action Alternative. **Tables 4.1.1-1** and **4.1.1-2** summarize the annual emissions associated with various phases and activities proposed in the No Action Alternative. The summaries come from the results of the No Action emission inventory, found in **Appendix D**.

Table 4.1.1-1. Annual Emissions for Development Phases of the No Action Alternative

Pollutant	Development Emissions (tons/year)[1,2]					
	Wind Erosion	Construction	Drilling	Completion	Interim Reclamation	Total (tons/yr)
NO_x	----	1.6	37.0	66.7	0.02	105.2
CO	----	0.5	20.3	34.1	0.02	54.9
VOC	----	0.1	2.3	3.9	0.003	6.3
SO_2	----	0.002	0.04	0.1	0.00004	0.1
PM_{10}	2.6	2.3	5.2	28.1	0.03	38.3
$PM_{2.5}$	0.4	0.5	1.8	6.3	0.01	8.9
Benzene	----	0.00071	0.020	0.034	0.000020	0.055
Toluene	----	----	0.0066	0.010	----	0.017
Ethylbenzene	----	----	----	----	----	----
Xylene	----	----	0.0045	0.0070	----	0.012
n-Hexane	----	----	----	----	----	----
Formaldehyde	----	0.0055	0.010	0.048	0.000054	0.063
Acrolein	----	0.00045	0.00081	0.0040	0.0000043	0.0052
CO_2	----	179	3,996	7,164	5.3	11,343
CH_4	----	0.0021	0.16	0.26	0.000019	0.42
N_2O	----	0.0003	0.032	0.051	0.000011	0.083
CO_2e [3]	----	179	4,009	7,185	5.3	11,379

[1] Assumes maximum development of eight wells in a single year on two new well pads, and two expanded pads.
[2] Emissions in summary tables may vary slightly due to rounding differences.
[3] Global warming potential, or CO_2 equivalents, equals $CO_2 + 25 \times CH_4 + 298 \times N_2O$.
[4] Carbon Dioxide Equivalent (CO_{2e})

Table 4.1.1-2. Total Annual Production Emissions from the No Action Alternative

Pollutant	Production Emissions (tons/year)[1,2]										
	Truck Loading	Workovers[4]	Generator Engines	Fugitive Emissions	Pneumatics	Flares	Heaters	Storage Tanks	Dehydrators	Production Traffic	Total (tons/yr)
NO_x	----	----	11.6	----	----	11.9	11.3	----	----	16.8	51.6
CO	----	----	23.2	----	----	3.0	9.5	----	----	5.3	41.0
VOC	31.2	----	8.1	17.5	6.9	----	0.6	110.9	8.7	1.6	185.4
SO_2	----	----	0.03	----	----	----	0.1	----	----	0.02	0.1
PM_{10}	----	----	0.8	----	----	----	0.9	----	----	31.2	32.9
$PM_{2.5}$	----	----	0.8	----	----	----	0.9	----	----	6.4	8.1
Benzene	0.063	----	0.068	0.028	0.0074	----	0.00024	0.29	0.70	0.013	1.17
Toluene	0.20	----	0.024	0.052	0.022	----	0.00039	0.47	3.17	----	3.94
Ethylbenzene	0.016	----	0.0011	0.0018	0.00080	----	----	0.025	0.10	----	0.15
Xylene	0.11	----	0.0084	0.024	0.011	----	----	0.20	2.70	----	3.05
n-Hexane	0.65	----	----	0.37	0.18	----	0.20	1.58	0.054	----	3.04
Formaldehyde	----	----	0.9	----	----	----	0.0085	----	----	0.13	1.02
Acrolein	----	----	0.11	----	----	----	----	----	----	0.010	0.12
CO_2	0.19	----	5,054	0.72	0.33	9,945	8,608	45.88	26.21	1,756	25,436
CH_4	1.84	----	0.10	10.37	5.14	0.19	0.16	6.28	2.24	0.038	26.4
N_2O	----	----	0.010	----	----	0.019	0.016	----	----	0.0042	0.049
CO_2e [3]	46	----	5,059	260	129	9,955	8,616	203	82	1,758	26,109

[1] Assumes maximum production from eight wells in a single year.
[2] Emissions in summary tables may vary slightly due to rounding differences.
[3] Global warming potential, or CO_2 equivalents, equals $CO_2 + 25 \times CH_4 + 298 \times N_2O$.
[4] Workovers would not likely occur the year the wells are drilled as workovers occur approximately every 1.5 years.

4.1.2 Proposed Action Alternative

4.1.2.1 Pollutant Emissions

Pollutant emissions have the potential to affect air quality on both a local and a regional scale. An emissions inventory for the criteria pollutants NOx, CO, SO_2, PM_{10}, $PM_{2.5}$, HAPs, and VOCs was created for development and operational-related activities for the Proposed Action Alternative (refer to **Appendix E**).

Emissions occur during two primary phases of the Proposed Action Alternative: the construction and development phase, and the operations phase. The construction and development phase includes emissions from the following activities:

- Construction
- Drilling
- Completion
- Interim reclamation
- Wind erosion

The operations or production phase includes emissions from:

- Generator engines
- Dehydrators
- Production heaters
- Well site tanks
- Pneumatics
- Fugitive emissions from components
- Well site truck loading emissions
- Well site flares
- Operations vehicle fugitive dust and tailpipe emissions

Criteria pollutants that could result from the above activities include: NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$, VOCs, and HAPs. The individual HAPs shown in the tables are those that are most meaningful based on largest emission quantities coupled with the lowest thresholds for potential adverse health effects discussed in **Section 3.1**, specifically benzene, toluene, ethylbenzene, xylenes, n-hexane, formaldehyde, and acrolein.

It is important to note that emissions from the construction and development phases of the Project are temporary in nature and as a result would have minimal opportunity to combine with other emission sources for lasting local impacts, or any regional impacts. In addition, potential emission sources from the Project are, in general, isolated from other large emission sources that may occur in the region. The sources are also small enough (as demonstrated in the attached emission inventory) that combination amongst Project sources would not be expected to pose a risk to established NAAQS and WAAQS.

In regard to the NAAQS and WAAQS, it is worth noting that for Wyoming State permit applications involving these types of oil and gas minor sources, WDEQ does not require dispersion modeling analysis.

It is assumed that a screening analysis has been done by or for WDEQ to show that these sources do not pose a threat to the standards.

Tables 4.1.2.1-1 and **4.1.2.1-2** summarize the annual emissions associated with various phases and activities proposed in the Proposed Action Alternative. The summaries come from the results of the Proposed Action Alternative emission inventory, found in **Appendix E**.

Table 4.1.2.1-1. Annual Emissions for Development Phases of the Proposed Action Alternative

Pollutant	Development Emissions (tons/year)[1,2]					Total (tons/yr)
	Wind Erosion	Construction	Drilling	Completion	Interim Reclamation	
NO_x	----	7.1	217.8	394.5	0.1	619.5
CO	----	2.5	119.1	200.9	0.1	322.6
VOC	----	0.4	13.3	23.3	0.01	37.0
SO_2	----	0.01	0.25	0.4	0.0002	0.7
PM_{10}	11.9	16.3	51.7	287.2	0.3	367.4
$PM_{2.5}$	1.8	2.8	12.5	49.3	0.04	66.4
Benzene	----	0.0032	0.12	0.2	0.00010	0.32
Toluene	----	----	0.039	0.1	----	0.10
Ethylbenzene	----	----	----	----	----	----
Xylene	----	----	0.027	0.0	----	0.068
n-Hexane	----	----	----	----	----	----
Formaldehyde	----	0.025	0.059	0.3	0.00027	0.39
Acrolein	----	0.0021	0.0050	0.0	0.000022	0.032
CO_2	----	818	23,543	42,372	25.9	66,759
CH_4	----	0.010	0.93	1.52	0.00009	2.46
N_2O	----	0.0015	0.19	0.30	0.00005	0.49
CO_2e [3]	----	819	23,622	42,499	25.9	66,966

[1] Assumes maximum development of 47 wells in a single year on six new well pads, and ten expanded pads.
[2] Emissions in summary tables may vary slightly due to rounding differences.
[3] Global warming potential, or CO_2 equivalents, equals $CO_2 + 25 \times CH_4 + 298 \times N_2O$.

Table 4.1.2.1-2. Total Annual Production Emissions from the Proposed Action Alternative

Pollutant	Production Emissions (tons/year)[1,2]										
	Truck Loading	Workovers[4]	Generator Engines	Fugitive Emission	Pneumatics	Flares	Heaters	Storage Tanks	Dehydrators	Production Traffic	Total (tons/yr)
NO_x	----	----	46.4	----	----	69.9	66.5	----	----	101.1	283.9
CO	----	----	92.7	----	----	17.5	55.9	----	----	29.8	195.9
VOC	187.4	----	32.4	102.5	40.8	----	3.7	635.1	51.1	9.3	1,062.4
SO_2	----	----	0.10	----	----	----	0.4	----	----	0.095	0.6
PM_{10}	----	----	3.3	----	----	----	5.1	----	----	233.8	242.2
$PM_{2.5}$	----	----	3.3	----	----	----	5.1	----	----	43.1	51.5
Benzene	0.37	----	0.27	0.16	0.043	----	0.0014	1.64	4.14	0.074	6.7
Toluene	1.22	----	0.10	0.31	0.13	----	0.0023	2.77	18.62	----	23.1
Ethylbenzene	0.10	----	0.0043	0.011	0.0047	----	----	0.15	0.60	----	0.9
Xylene	0.67	----	0.034	0.14	0.066	----	----	1.19	15.87	----	18.0
n-Hexane	4.02	----	----	2.16	1.07	----	1.20	9.24	0.32	----	18.0
Formaldehyd	----	----	3.5	----	----	----	0.050	----	----	0.75	4.3
Acrolein	----	----	0.45	----	----	----	----	----	----	0.062	0.5
CO_2	1.1	----	20,216	4.2	1.9	58,426	50,569	259.6	154.0	10,525	140,157
CH_4	11.1	----	0.38	60.9	30.2	1.10	0.95	36.1	13.2	0.23	154.1
N_2O	----	----	0.038	----	----	0.110	0.10	----	----	0.024	0.3
CO_2e [3]	279	----	20,237	1,527	757	58,486	50,622	1,161	483	10,538	144,089

[1] Assumes maximum production from 47 wells in a single year on six new well pads, and ten expanded pads.
[2] Emissions in summary tables may vary slightly due to rounding differences.
[3] Global warming potential, or CO_2 equivalents, equals $CO_2 + 25 \times CH_4 + 298 \times N_2O$.
[4] Workovers will not likely occur the year the wells are drilled as workovers occur approximately every 1.5 years.

4.1.2.2 Visual Air Quality and Acid Deposition

Potential impacts from a proposed project on visual air quality and air quality related values (AQRV) (i.e., acid deposition) are generally only of concern from a cumulative and long-range transport perspective. It typically would not be applicable for potential emission sources of this size and quantity to do a project-specific visual and related values analysis.

Potential visibility impacts, considered indirect impacts, from oil and gas construction and operation could occur primarily from particulate matter emissions, with the main source being vehicle fugitive dust. These impacts would be localized, and would be expected to disperse with local wind conditions. In addition, the distance to the nearest Class I area (estimated to be Washakie Wilderness Area over 150 kilometers/93 miles west of the Project Area) would make it extremely unlikely that the Project impacts could affect visibility conditions thresholds established for Class I areas.

The potential for acid deposition impacts falls under the same logic as the potential for adverse visibility impacts. Acid deposition impacts are calculated at sensitive lakes within Federal Class I areas, and as mentioned before, considering the size of the emissions and the distance to the nearest Class I area (93 miles west of the Project Area), it is assumed the potential for adverse impacts would be very minimal.

4.1.2.3 Ozone Impacts

Project-specific ozone impacts were not analyzed for this Project. Ozone impacts are traditionally analyzed on a regional scale. The potential for project-specific ozone impacts is anticipated to be minimal.

4.1.2.4 Greenhouse Gas Emission Impacts

Specific levels of significance have not yet been established by the USEPA or through the WDEQ. The lack of scientific models that predict climate change on a regional or local level prohibits the project-specific quantification of potential future impacts on climate change. Potential greenhouse gas impacts are believed to be global and cumulative in nature and are discussed further in **Section 5.1.2**.

4.1.3 Mitigation

The Proposed Action Alternative was designed to minimize and control air pollutant emissions with implementation of ACEPMs (**Section 2.2.8.1**) and other design features, such as well head telemetry for remote monitoring, “green” (flareless) completions, and air pollutant emissions controls imposed by the WDEQ Air Quality Division. No additional mitigation is recommended.

4.1.4 Residual Impacts

Minor emissions from production equipment could remain during the life of the Project. However, with implementation ACEPMs (**Section 2.2.8.1**) and other design features, air pollution emissions from the Proposed Action would be minimal, and no standards would be violated. GHGs from the Proposed Action would be a minor contribution to the overall emissions in the PRB. Residual effects to air quality would be less than significant.

4.2 GEOLOGIC RESOURCES

4.2.1 No Action Alternative

4.2.1.1 Topography

The No Action Alternative would result in topographical changes to approximately 21.5 acres of the Project Area on non-federal lands. Similar direct impacts to those described in **Section 4.2.2.1** would occur within the footprint of the two proposed well pads and 0.3 miles of proposed access roads, including a road upgrade. Indirect impacts related to alterations of visual character would only occur in areas where new pads and roads are constructed.

4.2.1.2 Geologic Hazards

The No Action Alternative is not anticipated to increase the instance of any geologic hazards within the Project Area. None of the proposed wells, pads, or road construction would occur within or above an abandoned mining site.

4.2.2 Proposed Action Alternative

4.2.2.1 Topography

The construction of pads and access roads would result in topographical changes to the Project Area. The Proposed Action would result in topographical changes to approximately 98.2 acres within the Project Area. The direct impacts described above would occur within the footprint of the six proposed well pads, four pad expansions, six facilities pads, and 1.8 miles of proposed access roads, including road upgrades. Indirect impacts related to alterations of visual character would only occur in areas where new pads and roads are constructed.

Topographical changes would consist primarily of rectangular and linear cuts and fills in soils and bedrock. The amount of cut and fill for each pad or access road would vary depending on the size of the disturbance, topographical grade, and the depth to bedrock. Any facilities located on hills or grades would require the most cut and fill per acre. These changes to topography would be expected to alter the visual character of the landscape. Also, any blasting or alteration of bedrock would permanently change the shape and thickness of the formations and could create fractures, which may serve as preferential pathways for material to move in or through bedrock.

Changes to topography have been minimized by EOG's development approach, which would utilize directional drilling and horizontal reaches to centralize well heads onto multi well pads. The use of these multi-well pads allows EOG to minimize the amount of access roads required to access all of the wells field-wide and to locate all of the proposed pads along a central corridor. This also reduces the amount of sections within the Project Area that would require topographical cuts and fills.

During final reclamation, all disturbed areas would be recontoured and returned, as close as possible, to their pre-disturbance condition.

4.2.2.2 Geologic Hazards

While some slope movement may occur at areas around cut and fill for the proposed pads, pad expansions, and access roads, the potential for a mass wasting event is not anticipated under the Proposed Action because the Project Area does not contain areas with high or moderate landslide potential. In addition, the Proposed Action is not anticipated to increase the risk of coal seam fires within the Project Area. Development of oil and gas facilities is not anticipated to increase the potential for seismic activity within the Project Area as no disposal or injection wells are proposed (USGS 2015b).

The Proposed Action is not anticipated to increase the instance of any geologic hazards within the Project Area. None of the proposed development would occur within or above an abandoned mining site.

4.2.3 Mitigation

With the implementation of interim and final reclamation, residual effects to geologic resources would be less than significant. No additional mitigation is recommended.

4.2.4 Residual Impacts

While changes in topography would be restored as part of final reclamation, any disturbance or damage to bedrock, if applicable, within the Project Area would be permanent. In addition, as no increase in geologic hazards is anticipated, no permanent impacts to geologic hazards would be anticipated.

4.3 SOILS

4.3.1 No Action Alternative

Under the No Action Alternative, horizontal oil and natural gas development would only occur on state or fee mineral estate and short-term surface disturbance would be approximately 21.1 acres. **Table 4.3.1-1** presents the proposed disturbance acreage for each soil map unit associated with the No Action Alternative. The soil map units not associated with surface disturbance were excluded from the table.

Table 4.3.1-1. Surface Disturbance of Soils in Project Area – No Action Alternative

Map Unit Symbol	Map Unit Name	Acres in Project Area	Short-Term Disturbance (acres)[1]
131	Shingle-Badland-Samday complex, 10 to 30 percent slopes	6,197.7	11.5
144	Ulm-Renohill clay loams, 6 to 15 percent slopes	321.9	9.6
	Total	6,519.6	21.1[1]

Source: USDA-NRCS 2014

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

Soil stabilization techniques would be utilized on a case-by-case basis to mitigate potential soil losses and other erosive forces. In addition, construction on steep slopes greater than 25 percent would be avoided, where feasible.

4.3.2 Proposed Action Alternative

Impacts to soil resources within the Project Area are directly related to the amount of surface disturbance and could lead to the potential reduction of soil quality. Soil related impacts within the Project Area would result from soil disturbance due to the use of heavy machinery, the removal of vegetation, and intermixing of topsoil and subsoil during grading and stockpiling. Important factors in determining the occurrence of soil impacts include the characteristics of the major soil types, vegetative cover, and slope.

Direct soil impacts include soil horizon disturbances to the surface and subsurface horizons resulting from site clearing, cut and fills, and location and access road grading. Indirect impacts include soil loss from wind, rain, and other erosive forces following horizon disturbances. Some soil erosion is expected to occur due to exposed soils on the proposed well pads and access roads.

As vegetative cover is removed and the structural stability of the soil is disrupted, the potential for erosion increases. This potential degree of erosion depends upon slope, runoff probability, soil texture, and soil structure. Finely textured soils with poor structure are generally more prone to water erosion than coarse, sandy soils. Silts loams and silty clay loams are particularly vulnerable to water erosion due to their fine particle size and decreased cohesiveness. However, elevated sandy textures make soils more sensitive to wind erosion. The majority of the Project Area contains soils that have a moderate water erosion potential rating and a moderate wind erodibility rating. As stated in **Section 3.3.2.1**, approximately 23,036.0 acres (94.9 percent) of the soils in the Project Area have moderate water erosion potential and approximately 17,876.9 acres (73.6 percent) of the soils in the Project Area have moderate wind erodibility. Therefore, the soils within the Project Area are susceptible to erosive forces, especially in the absence of vegetative cover following grading and compaction from heavy machinery.

Steep slopes can be highly susceptible to erosion regardless of soil texture. Some erosion potential may exist at each site, depending on surface disturbance, site-specific slope, soil type, erosion risk, and construction technique and/or long-term maintenance. However, successful interim and final reclamation is likely throughout a majority of the Project Area due to approximately 15,971.0 acres (65.8 percent) of the soils within the Project Area having a high restoration potential. Only 111.2 acres (0.5 percent) of the soils within the Project Area have a low restoration potential. EOG would also use grading, site preparation BMPs, and other soil retention measures to reduce the potential soil loss and wasting during site construction and operation (**Section 2.2.8.2**). EOG also avoided siting construction on steep slopes greater than 25 percent where feasible to reduce potential soil losses and wasting (**Section 2.2.8.2**).

Under the Proposed Action Alternative, short-term surface disturbance would be approximately 94.3 acres. **Table 4.3.2-1** presents the proposed disturbance for each soil map unit in the Project Area; no surface disturbance is proposed on those soil map units not represented in the table. In addition, **Table 4.3.2-1** provides the water erosion potential, wind erodibility, erosion hazard, and restoration potential ratings for each soil map unit proposed for surface disturbance according to the thresholds discussed in **Section 3.3.2.1**.

Table 4.3.2-1. Surface Disturbance of Soils in Project Area – Proposed Action Alternative

Map Unit Symbol	Map Unit Name	Acres in Project Area	Short-Term Disturbance (acres)[1]	Kw-Factor	Wind Erodibility Index	Erosion Hazard	Restoration Potential
101	Absted-Arvada-Bone complex, 0 to 6 percent slopes	111.2	9.6	Moderate	Low	Slight	Low
107	Clarkelen-Draknab complex, 0 to 3 percent slopes	1,526.9	0.8	Moderate	Moderate	Slight	High
108	Clarkelen-Dwyer-Orpha association, 0 to 10 percent slopes	59.5	8.4	Moderate	High	Slight	High
113	Dwyer-Orpha loamy sands, 3 to 15 percent slopes	1,538.8	3.7	Low	High	Slight	High
114	Forkwood-Cambria fine sandy loams, 0 to 6 percent slopes	1,931.8	8.5	Moderate	Moderate	Slight	High
121	Hiland-Bowbac sandy loams, 0 to 6 percent slopes	1,961.4	18.5	Moderate	Moderate	Slight	High
122	Hiland-Bowbac complex, 6 to 15 percent slopes	2,046.9	1.3	Low	Moderate	Slight	High
131	Shingle-Badland-Samday complex, 10 to 30 percent slopes	6,197.7	24.0	Moderate	Moderate	Moderate	Moderate
136	Tassel-Terro-Rock outcrop complex, 15 to 30 percent slopes	1,114.1	2.1	Moderate	High	Moderate	Moderate
143	Ulm-Renohill complex, 0 to 6 percent slopes	372.5	3.4	Moderate	Low	Slight	High
144	Ulm-Renohill clay loams, 6 to 15 percent slopes	321.9	9.6	Moderate	Low	Slight	High
150	Zigweid-Bahl association, 0 to 6 percent slopes	514.7	3.9	Moderate	Low	Slight	High
212	Ustic Torriorthents, gullied	1,888.2	0.5	Moderate	Low	Moderate	High
	Total	19,585.6	94.3[1]				

Source: USDA-NRCS 2014

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

A majority of the soil map units within areas proposed for surface disturbance are characterized as having a moderate water erosion potential, a slight erosion hazard rating, and a high restoration potential. The wind erodibility of the disturbed soils in the Project Area range from low to high, with a majority of the soils having a low to moderate wind erodibility. Soils within areas proposed for disturbance would be susceptible to erosive forces. This is due to their erosion ratings and location within areas proposed for surface disturbance. However, the majority of disturbed soils have a high restoration potential and successful interim and final reclamation would be likely.

4.3.3 Mitigation

The Proposed Action Alternative was designed to minimize surface disturbance and erosion on all soil types, with implementation of the ACEPMs (**Section 2.2.8.2**) and other design features, such as interim and final reclamation. The following mitigation measures would also be implemented.

- All fill material would be placed in shallow lifts (6 to 12 inches), moisture applied, and compacted to a 95 percent maximum standard density.
- The guidance provided in the Wyoming Policy on Reclamation (IM WY-2012-032) would be followed; additional details are available on the BLM's website http://www.blm.gov/wy/st/en/programs/reclamation.html.
- Except as otherwise provided in an approved Surface Plan of Operations, the Operator must not conduct operations in areas subject to mass soil movement, riparian areas, floodplains, lakeshores, and/or wetlands. The Operator also must take measures to minimize or prevent erosion and sediment production. Such measures may include, but are not limited to:
  - Avoiding excessive land clearing when siting structures, facilities, and other improvements; and
  - Using erosion control methods such as, but not limited to, re-vegetating the disturbed areas as soon as possible, erosion control mats, waddles, mulch, hydro-mulch, silt fences, water bars, eyebrow ditches, diversion ditches, wing ditches, gabion baskets or rip rap and any other method approved by the AO.
- Lessees and operators must submit for BLM approval a request on Form 3160-5 before:
  - Undertaking any subsequent new construction outside the approved area of operations; or
  - Reconstructing or altering existing facilities including, but not limited to, roads, emergency pits, firewalls, flowlines, or other production facilities on any lease that would result in additional surface disturbance. If, at the time the original APD was filed, the lessee or operator elected to defer submitting information under Section III.E.3.d (Location of Existing and/or Proposed Facilities) of Onshore Order No. 1, the lessee or operator must supply this information before construction and installation of the facilities. The BLM may require a field inspection before approving the proposal. The lessee or operator may not begin construction until the BLM approves the proposed plan in writing. The operator must certify on Form 3160-5 that they have made a good faith effort to provide a copy of any proposal involving new surface disturbance to the private surface owner in the case of split estate.
- The use of temporary protective surface treatment on disturbed areas shall be applied on a case-by-case basis as Project conditions warrant.
- Re-seed all disturbed areas with native species adapted to the site conditions and capable of providing protective soil cover. All seed must be certified weed-free. When practical, reseeding of

disturbed areas should include the use of locally harvested seed from comparable areas in Wyoming and surrounding areas. Private surface owners may dictate seed mixes where applicable.

- Proposed surface-disturbing activities would be modified (located) to avoid areas of highly erosive soils to the greatest extent practicable. When avoidance of highly erosive soils is not practical the operator shall submit an individual site plan to and be approved by the AO meeting the following requirements. Engineered drawings for construction, site drainage design, and final rehabilitation contours within a written rationale describing how the proposed controls will prevent slope failure and erosion, while maintaining viable topsoil for final reclamation. This plan should also include a timeline identifying the actions that will be applied during the construction, production, and rehabilitation phases of the plan so appropriate monitoring protocols can be developed by the BLM to ensure that the plan is meeting the objective described in its rationale.
- Soil compaction would be remediated on all compacted surfaces and prior to the redistribution of topsoil on disturbed surfaces to the depth of compaction by methods that prevent mixing of the soil horizons. BLM's recommended methods are subsoiling, paraplowing, or ripping with a winged shank. Scarification is acceptable on areas identified as very shallow soils in the Master Surface Use Plan (MSUP).
- Earthwork for final reclamation generally must be completed within six months of well plugging (weather and private surface owner permitting).

4.3.4 Residual Impacts

Residual impacts to soils would be reduced after implementation of mitigation measures. The surface disturbance resulting from the Proposed Action would remain until interim and final reclamation area successful. Following successful final reclamation, areas where excavation and filling occurred will have been subjected to the mixing of soil horizons. This is considered a permanent alteration of soil resources in those areas. If any minor declines in soil productivity occur, they would likely be negligible over time.

4.4 WATER RESOURCES, INCLUDING SURFACE AND GROUNDWATER QUALITY, HYDROLOGIC (STORMWATER) CONDITION, FLOODPLAINS, AND WATERS OF THE UNITED STATES

4.4.1 No Action Alternative

Overall, impacts to water resources would be similar in nature, but less in extent to those described for the Proposed Action (**Section 4.4.2**). However, the No Action Alternative would have no direct effect on USGS-mapped streams and the distance of proposed construction areas to Antelope Creek, Bates Creek, and Sand Creek would be greater than under the Proposed Action. The distance of the closest proposed construction areas and their relation to Antelope Creek, Bates Creek, and Sand Creek are presented below in **Table 4.4.1-1**. In addition, no FEMA 100-year floodplains occur within the Project Area; therefore, FEMA 100-year floodplains would not be affected by the No Action Alternative.

Table 4.4.1-1. Distance of Closest Proposed Construction Areas to Streams in the Project Area under the No Action Alternative

Stream	Distance of Closest Proposed Construction Area to Stream (feet)[1]	Stream Located Up or Down Gradient of Proposed Construction Area
Antelope Creek	14,125	Down Gradient
Bates Creek	27,775	Down Gradient
Sand Creek	14,850	Down Gradient

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.4.2 Proposed Action Alternative

Throughout the Project Area, potential impacts to water resources would vary in magnitude depending on several factors, such as the proximity of a particular disturbance area to Antelope Creek, Bates Creek, Sand Creek, and associated tributaries; slope aspect and gradient; soil type; the timing and period of construction activities; and the timeliness and effectiveness of reclamation and erosion efforts. This EA assumes streams located topographically down gradient and close to proposed construction areas would potentially be affected more than those located topographically down gradient and far from proposed construction areas, or those located up gradient which would not be affected. The distance of the closest proposed construction areas and their relation to Antelope Creek, Bates Creek, and Sand Creek are presented below in **Table 4.4.2-1**. The potential for adverse effects to water resources would be greatest during the construction and drilling phase and would lessen during the productive life of the well due to natural soil and plant stabilization, reclamation, revegetation efforts, and reduction in water usage. Impacts to surface water and groundwater resources could include increased sedimentation, reduction in water quality, and water depletion.

Table 4.4.2-1. Distance of Closest Proposed Construction Areas to Streams in the Project Area Under the Proposed Action Alternative

Stream	Distance of Closest Proposed Construction Area to Stream (feet)[1]	Stream Located Up or Down Gradient of Proposed Construction Area
Antelope Creek	675	Down Gradient
Bates Creek	7,900	Down Gradient
Sand Creek	530	Down Gradient

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.4.2.1 Surface Water Resources

Increased Sedimentation

Removal of vegetation cover and soil compaction on well pads and access roads would potentially result in an increase in surface erosion within the Project Area. Surface erosion rates are dependent on site topography, precipitation intensity and quantity, soil type, land use, and nature of construction activity (USEPA 2009). An increase in surface erosion would directly impact surface water within the Project Area and result in an increase in sedimentation output into Antelope Creek, Bates Creek, Sand Creek, and

associated tributaries and drainages. Additionally, soil compaction on well pads and access roads may lead to increased stormwater runoff when compared to pre-disturbance levels. Due to the increase in surface erosion, more soil is available for transport into local drainages by snow melt and storm events. Any increase in erosion and sedimentation would continue until all disturbed areas are returned to their natural contours and are revegetated successfully.

An increase in sediment load into Antelope Creek, Bates Creek, Sand Creek, and associated tributaries may increase salinity and turbidity in segments downriver from the proposed disturbance. Increased runoff from soil compaction may lead to increased peak flows in Antelope Creek and other surface water features in the Project Area. Increased flow rates may increase erosion on channel banks and further increase the sediment load within the surface water features. If a sufficient increase in sedimentation were to occur, the sediment volume could clog stream channels, degrade aquatic habitat by covering stream substrates with fine sediment, and act as a carrier for other pollutants (trace metal, pesticides, plant nutrients, etc.). The amount of sediment deposited within Antelope Creek and other surface water resources in the Project Area would depend on natural and geographic factors, along with the relative success of ACEPMs and erosion control measures. Implementing erosion control BMPs, Project design features, and interim and final reclamation would reduce the project-related increase in sediment deposited into Antelope Creek, Bates Creek, Sand Creek, and associated tributaries.

Water Quality

Surface water quality in the Project Area may be impacted if an accidental spill would occur. An accidental spill could increase toxic chemical content in Antelope Creek, Bates Creek, Sand Creek, and associated tributaries, reduce aquatic habitat quality, and potentially lead to mortality of aquatic species. The magnitude of the impact from an inadvertent release would depend upon proximity to surface water features, spill volume, type of material introduced, soil permeability, slope aspect and gradient of the spill site, and timing and intensity of precipitation events. EOG would use established methods to minimize the potential for accidental spills and would apply practices described in Onshore Oil and Gas Order No. 1. For example, EOG would conduct SPCC inspections of well sites. Any deficiencies would be documented and repaired as soon as possible. If an accidental spill were to occur, berms surrounding the well pad production facilities would contain the hazardous fluids. Even in the absence of a spill, pollutants from construction equipment and materials used during construction and drilling activities could be inadvertently carried to surface water resources in the Project Area by stormwater runoff or by erosion of debris and particulate matter (USEPA 2009). Any chemicals or potentially hazardous materials would be handled in accordance with EOG's SPCC plan. Provisions established under the SPCC plan would minimize or eliminate potential impacts to any surface waters associated with an accidental spill. As discussed above, a potential increase in sedimentation would cause an increase in the turbidity, salinity, and overall pollution of downstream surface waters; therefore, increased sedimentation may also lead to a decrease in water quality of water resources within the Project Area.

Water Depletion

EOG is not planning to use surface water sources for the project. Should access to existing WDEQ-permitted water sources for this project be limited, EOG may request to use municipal water sources. Groundwater Resources

Water Quality

Potential impacts to groundwater would include contamination from produced water, drilling mud, and petroleum constituents during drilling and completion activities. However, these impacts are unlikely due to the depth of the proposed well bores and well casing requirements. Hydraulic fracturing is not likely to have an effect on groundwater quality, although the potential impacts on underground sources of drinking water from hydraulic fracturing are not well known. Approximately 98 percent of the fracturing fluid is comprised of water and sand. The fracturing fluid injected into the target formation is confined by thousands of feet of rock layers from shallower potable water aquifers. Casing and cementing procedures are designed to protect and isolate all usable water zones. Additionally, fracture stimulation fluids would be flowed back into above-ground tanks and hauled to a WDEQ-authorized disposal site. If production is established, produced water would be stored in tanks and visited by a pumper daily. No open pits would be used. Therefore, impacts to groundwater and surface water from produced water leaks and spills are unlikely. EOG tests water wells in compliance with State law.

Water Depletion

Each well would require approximately 153,500 to 303,500 bbl of groundwater to drill and complete. Additional water would be used for dust suppression on roads. During well completion, large-volume groundwater removal and significant dewatering have the potential to occur. However, water use may be reduced by recycling drilling mud for use in subsequent drilling operations.

Indirect impacts to groundwater resources could occur if significant dewatering and other large-volume groundwater removal occur during well completion. These impacts include declines in the water level within nearby water wells, which would result in the decrease of available water needed for livestock watering, domestic needs, and irrigation. EOG's water needs for drilling, completion, and dust abatement would be obtained from the WDEQ-permitted sources identified in **Table 2.2.3-2**.

4.4.2.2 Hydrologic (Stormwater) Condition

The Proposed Action would remove approximately 98.2 acres of vegetation cover. As stated in **Section 4.6.2**, vegetation removal within areas of surface disturbance could potentially lead to increased erosion, sedimentation, and runoff potential. Stormwater runoff would flow to Antelope Creek, Bates Creek, and Sand Creek, and associated tributaries. However, the well pads and roads would be engineered and constructed to minimize the suspended solid concentration of surface runoff, avoid disruption of drainages, and minimize direct impacts to surface water. Topography, natural drainage, and erosion control were considered during the planning for each proposed location. The access roads would be maintained to prevent erosion, off-site deposition, and ensure safe conditions during the life of the well. Refer to **Section 2.2.8.2** for a lists of ACEPMs EOG would use to limit the potential impacts associated with stormwater runoff and soil stabilization.

4.4.2.3 Floodplains and Waters of the United States

All well pad and access road locations were sited to minimize impacts to surface waters, floodplains, and Waters of the United States. The Proposed Action would impact approximately 1,201 linear feet of USGS-mapped streams and no linear feet of FEMA-mapped streams in the Project Area (**Table 4.4.2.4-1**). No

FEMA 100-year floodplains occur within the Project Area; therefore, FEMA 100-year floodplains would not be affected by the Proposed Action.

Table 4.4.2.4-1. USGS-Mapped Stream Features under the Proposed Action Alternative

Stream Classification	Linear Feet within the Project Area	Linear Feet in Areas of Surface Disturbance[1]
Ephemeral Streams	0.0	0
Intermittent Streams	757,874.2	1,201
Perennial Streams	7,121.8	0
Canals/Ditches	23,406.9	0
Total	**788,402.9**	**1,201**

Source: USGS 2006

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.4.3 Mitigation

Design features, closed-loop drilling, erosion control measures, and ACEPMs (**Section 2.2.8.3**) would be employed to help mitigate or reduce the impacts described above. In addition, EOG would implement a SPCC plan to minimize or eliminate potential impacts to any surface waters associated with an accidental spill. The following mitigation measures would also be implemented.

- Site-specific ground surveys would be required to verify the existence of these USGS- -mapped streams, in addition to determining if these features and other existing unmapped streams or wetlands would be considered potentially jurisdictional.
- BMPs and a SWPPP would be implemented to minimize impacts to water quality.

4.4.4 Residual Impacts

Residual impacts to water resources would be expected to be minimal after implementation of mitigation measures and compliance with applicable state and federal regulations. If any minor declines in water quality occur, they would be negligible over time assuming erosion is controlled and spills are insignificant.

4.5 MINERAL RESOURCES

4.5.1 No Action Alternative

4.5.1.1 Locatable Minerals

The No Action Alternative would prevent the surficial development of locatable mineral operations on approximately 21.5 acres in the Project Area. Additionally, the development of eight horizontal oil and natural gas wells would limit the amount of subsurface mineral resources that are available for extraction during the life of the Project. Following final reclamation, the surface of the Project Area would be available for the development of locatable mining operations; however, the eight remaining well casings would permanently underlie the Project Area and could be prohibitive to the extraction of minerals in their direct vicinity.

4.5.1.2 Leasable Minerals

Under the No Action Alternative, eight horizontal oil and natural gas wells would be developed in the Project Area from two proposed and two existing well pads located on fee and state surface estate. This could result in the removal of approximately 1,102,400 bbls of oil over the life of the Project. These wells would also produce natural gas, which would reduce the amount of available natural gas within reserves underlying the Project Area.

As of June 2015, the surface disturbance boundary of the Antelope Mine was approximately 2,845 feet from the surface disturbance proposed under the No Action Alternative. The No Action Alternative is not anticipated to prevent access to any of the leased minerals held by the Antelope Mine.

4.5.2 Proposed Action Alternative

4.5.2.1 Locatable Minerals

Oil and gas development within the Project Area would not result in conflicts with any active mining operations for locatable minerals. While there would be no conflict with any existing locatable mineral mining operations, surface and subsurface oil and gas development would prevent other mining operations from commencing within the Project Area. Following abandonment and final reclamation, other mining operations could utilize and access the subsurface mineral resources within the Project Area. Direct and indirect impacts to other mineral reserves underlying the Project Area could include potential contamination of the resource by drilling fluids and physical obstruction of resources by well casings. The potential for these indirect impacts would be minimal, but commensurate with the number of wells drilled under each alternative. This EA assumes casings would remain in place following production and therefore could serve as an obstruction to the access of other minerals close to the well bore. However, EOG would be required to design a casing program for each well and test the casing integrity; this would greatly reduce the potential of an inadvertent release of hydrocarbons into locatable mineral bearing formations.

The Proposed Action would prevent the surficial development of locatable mineral operations on approximately 98.2 acres of the Project Area. The installation of 47 new wells would limit the amount of subsurface mineral resources that are available for extraction during the life of the Project. Following final reclamation the surface of the Project Area would be available for the development of locatable mining operations, but the 47 remaining well casings would permanently underlie the Project Area and could be prohibitive to the extraction of minerals in their direct vicinity.

4.5.2.2 Leasable Minerals

The development of new oil and gas facilities within the Project Area would result in the depletion of oil and natural gas resources from the Turner and Parkman formations, and possibly the Mowry, Niobrara, Shannon, Sussex, or other formations if they are added as target formations via Sundry Notice. The FEIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003) estimates that the average life of a productive non coal bed methane oil well is 15 years and the average production of a well is 137,800 bbls over the life of the well. Conservatively, it is assumed that each exploratory well would be a producing well. Estimates for natural gas recovery within the Project Area are not available, but it is assumed that implementation of the Proposed Action would result in the drawdown of natural gas reserves underlying

the Project Area. The extent of natural gas drawdown would be commensurate with the number of wells drilled. The Proposed Action would result in the development of 47 oil and natural gas wells within the Project Area. This could result in the removal of approximately 6,476,600 bbls of oil over the life of the Project. These wells would also produce natural gas, which would reduce the amount of available natural gas within reserves underlying the Project Area.

Other impacts to hydrocarbon bearing formations could include potential contamination by drilling fluids and physical obstruction of resources by well casings.

Potential conflicts with the Antelope Mine could occur as surface disturbance would occur within 10 feet of the permit boundary. If activities at Antelope Mine were to extend southwest toward the proposed well locations, potential for conflicts with proposed oil and gas activities could exist. However, based on the existing condition, no coal reserves would be drawn down as a result of the Proposed Action. As of June 2015, the surface disturbance boundary of the Antelope Mine was approximately 1,715 feet from the surface disturbance associated with the Proposed Action. While the potential for indirect impacts from the proposed Project on coal mining may exist, the Proposed Action would not be expected to prevent access to any of the leased minerals held by the Antelope Mine.

4.5.3 Mitigation

Casing, and cementing procedures would be employed to help minimize the potential for contamination of the locatable minerals by drilling fluids. No additional mitigation is recommended.

4.5.4 Residual Impacts

Any locatable minerals that are exposed to drilling fluids or other hazardous materials from accidental casing failures could be damaged. The introduction of hydrocarbons, produced water, or drilling fluids into other recoverable mineral resources could permanently reduce their value or their ability to be recovered. Well bores, once drilled and cased, would not be removed upon final reclamation and could serve as permanent obstructions to locatable mineral sources.

The removal of hydrocarbon resources from the target formations underneath the Project Area would constitute a permanent loss of oil and natural gas from the Turner and Parkman formations. The Proposed Action could result in depletions to the Mowry, Niobrara, Shannon, Sussex, or other formations if they are added (via sundry) as target formations for the proposed wells. As well bores and casings would not be removed during final reclamation, well bores could serve as permanent obstructions to leasable mineral sources.

4.6 VEGETATION, INCLUDING GRASSLAND AND SHRUBLAND COMMUNITIES, RIPARIAN AND WETLAND COMMUNITIES, INVASIVE AND NONNATIVE PLANT SPECIES, PEST CONTROL, AND SPECIAL STATUS SPECIES

4.6.1 No Action Alternative

4.6.1.1 General Vegetation, Including Grassland, Shrubland, Riparian, and Wetland Communities

Under the No Action Alternative, eight horizontal oil and natural gas wells would be developed in the Project Area from two proposed and two existing well pads located on fee and state surface estate. The No Action Alternative would result in the direct, short-term loss of approximately 21.6 acres. **Table 4.6.1.1-1** lists the acreage of short-term disturbance to each ecological site under the No Action Alternative. No NWI-wetlands would be directly affected. Other potential impacts to vegetation communities would be similar to the Proposed Action, but less in extent as fewer pads and roads would be constructed in the Project Area.

Table 4.6.1.1-1. Ecological Sites Impacted under the No Action Alternative

Ecological Site Description	Acres within the Project Area*	Acres of Short-Term Disturbance*,1
Clayey (Cy) 10-14" Northern Plains Precipitation Zone	1,506.2	9.6
Clayey Overflow (CyO) 10-14" Northern Plains Precipitation Zone	19.7	0
Loamy (Ly) 10-14" Northern Plains Precipitation Zone	8,806.2	0
Lowland (LL) 10-14" Northern Plains Precipitation Zone	1,869.1	0
Saline Upland (SU) 10-14" Northern Plains Precipitation Zone	111.2	0
Sands (Sa) 10-14" Northern Plains Precipitation Zone	2,134.4	0
Shallow Clayey (SwCy) 10-14" Northern Plains Precipitation Zone	215.5	0
Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone	8,224.6	11.1
Shallow Sandy (SwSy) 10-14" Northern Plains Precipitation Zone	1,139.5	0
Very Shallow (VS) 10-14" Northern Plains Precipitation Zone	253.6	0
Water	4.6	0
Total	**24,284.6**	**21.6**

* Minor discrepancies may exist due to rounding
[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.6.1.2 Invasive and Nonnative Plant Species and Pest Control

Under the No Action Alternative, the potential for the invasion and establishment of invasive and noxious weed species would be similar to the Proposed Action, but less in extent as fewer roads would be constructed and fewer Project-related vehicles would travel on existing access roads in the Project Area.

4.6.1.3 Special Status Species

Federally Listed Species

Ute Ladies'-Tresses

The No Action Alternative would have no direct effect on marginal suitable habitat for the Ute ladies'-tresses, and would not be expected to indirectly affect marginal suitable habitat for Ute ladies'-tresses, as the distance of the closest proposed construction area to marginal suitable habitat would be approximately 16,000 feet (3.0 miles) (HWA 2015b).

Since all known populations of Ute ladies-tresses' are either upstream and/or outside of the Project Area; no impacts to previously recorded populations are anticipated under the No Action Alternative. As no Ute ladies'-tresses populations have been previously identified within the Project Area and marginal suitable habitat would not be directly affected, the No Action Alternative ***will have No Effect to*** Ute ladies'-tresses.

Agency Specific Sensitive Species

Barr's Milkvetch

The No Action Alternative would result in a loss of approximately 20.7 acres of potential habitat for the Barr's milkvetch. Based on the occurrence of WYNDD-mapped potential habitat in the Project Area and the observation of Barr's milkvetch individuals in the Antelope Creek Watershed and portion of the TBNG that overlaps with the Project Area, the No Action Alternative may affect individual Barr's milkvetch in the Project Area., but would not likely lead towards federal listing of the species.

4.6.2 Proposed Action Alternative

4.6.2.1 General Vegetation, Including Grassland, Shrubland, Riparian, and Wetland Communities

Direct impacts to vegetation would include loss of biomass and a potential change in species composition and community structure, loss of wildlife habitat, decreased forage production, and the potential for invasive plant introduction. Some vegetation loss would be short term, as areas are reclaimed during the production phase (interim reclamation). Grasses and forbs are expected to re-establish within a few growing seasons after reclamation, while woody species, such as sagebrush, would take several years to return. Long-term loss of vegetation would be associated with operation and maintenance activities. These areas would be reclaimed once the well is removed from production (final reclamation). The indirect impacts resulting from the removal of vegetation within the Project Area would include increased potential for

topsoil erosion, fugitive dust, increased potential for the invasion of noxious weed species, and potential degradation and loss of topsoil and soil microorganisms.

Surface disturbances associated with the construction of the proposed well sites and access roads would present opportunities for weed invasion and spread. Gelbard and Belnap (2003) found roads to be a conduit for exotic species invasions due to shifts in habitat type, stress on native species, and introduction of movement corridors. Some exotic plants species also prefer disturbed areas such as roadsides (Gelbard and Belnap 2003). Direct impacts to native vegetation from weed infestations in the Project Area may include the loss of wildlife habitat, and reduced rangeland productivity and native plant species diversity. Indirect impacts resulting from weed infestations could result in changes in the fire cycle from cheatgrass proliferation on disturbed soils and increased costs from weed management efforts. Additionally, surface disturbance from the proposed Project would cause fugitive dust to be deposited on vegetated areas within the Project Area during construction and on vegetation along access roads throughout the production stage. As a result, an interference with photosynthesis may impact vegetation within the Project Area by reducing plant vigor, productivity, and health.

The Proposed Action would result in the direct, short-term loss of 94.2 acres. **Table 4.6.2.1-1** lists the short-term disturbance to each ecological site under the Proposed Action. Following construction, drilling, and completion activities, interim reclamation would occur in areas not needed for the remainder of the proposed Project. Lands involved in interim and final reclamation efforts would be recontoured and revegetated using a seed mixture approved by the landowners. Interim reclamation activities would be implemented within six months of well completion and if a satisfactory stand of vegetation is not achieved, reseeding efforts would be repeated. Disturbance areas needed for well production would remain for the life of the Project. Final reclamation would then restore the land, as near as possible, to original conditions.

Table 4.6.2.1-1. Ecological Sites Impacted under the Proposed Action

Ecological Site Description	Acres within the Project Area*	Acres of Short-Term Disturbance*,[1]
Clayey (Cy) 10-14” Northern Plains Precipitation Zone	1,506.2	13.0
Clayey Overflow (CyO) 10-14” Northern Plains Precipitation Zone	19.7	0.0
Loamy (Ly) 10-14” Northern Plains Precipitation Zone	8,806.2	32.1
Lowland (LL) 10-14” Northern Plains Precipitation Zone	1,869.1	9.2
Saline Upland (SU) 10-14” Northern Plains Precipitation Zone	111.2	9.6
Sands (Sa) 10-14” Northern Plains Precipitation Zone	2,134.4	3.7
Shallow Clayey (SwCy) 10-14” Northern Plains Precipitation Zone	215.5	0.0
Shallow Loamy (SwLy) 10-14” Northern Plains Precipitation Zone	8,224.6	24.6
Shallow Sandy (SwSy) 10-14” Northern Plains Precipitation Zone	1,139.5	2.1
Very Shallow (VS) 10-14” Northern Plains Precipitation Zone	253.6	0.0
Water	4.6	0.0
Total	**24,284.6**	**94.2**

*Minor discrepancies may exist due to rounding.
[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

A majority of surface disturbance associated with the Proposed Action would occur in the Loamy (Ly) 10-14" Northern Plains Precipitation Zone and Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone ecological sites. As stated in **Section 3.6.1**, the Loamy (Ly) 10-14" Northern Plains Precipitation Zone ecological site is characterized as rangeland. The vegetation composition associated with this site is made up of approximately 75 percent grasses, 10 percent big sagebrush, and a variety of half-shrubs and forbs make up the remainder (USDA-NRCS 2011). The Shallow Loamy (SwLy) 10-14" Northern Plains Precipitation Zone ecological site is also characterized as rangeland. This site is dominated by cool season midgrasses with scattered patterns of big sagebrush (USDA-NRCS 2011).

4.6.2.2 Invasive and Nonnative Plant Species and Pest Control

Surface disturbance within the Project Area would provide an opportunity for the introduction and expansion of invasive and noxious weed species into native vegetation communities. This effect would be greatest along existing roadways as well as areas associated with construction of the well pads and access roads. Roads are known to serve as a vector for the spread of noxious and invasive plants as vehicles may carry seeds from currently infested areas (Gelbard and Belnap 2003). The clearing of vegetation and soils from grading would create areas of bare soil that would be susceptible to exotic seed establishment (Trombulak and Frissell 2000). Negative effects on the landscape resulting from the establishment of noxious and invasive weeds can include: 1) reduction in the overall visual character of an area; 2) competition with, or elimination of native plants; 3) reduction or fragmentation of wildlife and threatened and endangered plant habitats; and 4) increased soil erosion (Gelbard and Belnap 2003).

4.6.2.3 Special Status Species

Conclusions regarding the effects of the Proposed Action on the species as well as a determination of effect are presented in the conclusions and determination section at the end of the analysis for the special status plant species, as needed.

Federally Listed Species

Ute Ladies'-Tresses

The Proposed Action would have no direct effect on marginal suitable habitat for the Ute ladies'-tresses/ There would be the potential to indirectly affect marginal suitable habitat for Ute ladies'-tresses, as the distance of the closest proposed construction area to marginal suitable habitat would be approximately 540 feet (0.1 miles), which would be for a proposed access road (HWA 2015b). Potential indirect effects that could affect Ute ladies'-tresses would include:

- habitat loss and population fragmentation due to construction of access roads and other infrastructures;
- over-collection due to the increase in human presence;
- competition from exotic weed species due to the creation of disturbed areas and removal of native vegetation;
- hydrology changes as a result of impacts to water resources; and
- loss of pollinators due to the removal of pollen-rich native vegetation in Ute ladies-tresses habitat and elimination of pollinator habitat (USFWS 2005).

Since all known populations of Ute ladies-tresses' are either upstream and/or outside of the Project Area; no impacts to previously recorded populations are anticipated under the Proposed Action. As no Ute ladies'-tresses populations have been previously identified within the Project Area and marginal suitable habitat would not be directly affected, the Proposed Action ***may affect, is not likely to adversely affect*** Ute ladies'-tresses.

Agency Specific Sensitive Species

Barr's Milkvetch

The Proposed Action would result in a loss of approximately 20.7 acres of potential habitat for the Barr's milkvetch. Based on the occurrence of WYNDD-mapped potential habitat in the Project Area and the observation of Barr's milkvetch individuals in the Antelope Creek Watershed and portion of the TBNG that overlaps with the Project Area, the Proposed Action may affect individual Barr's milkvetch in the Project Area., but would not likely lead towards federal listing of the species.

4.6.3 Mitigation

Interim and final reclamation activities, in conjunction with ACEPMs (**Section 2.2.8.4**) to control weeds and avoid Ute ladies'-tresses individuals, would help to mitigate or reduce the impacts described above. In addition, the following mitigation measures would also be implemented:

- Reseeded areas would be temporarily fenced for at least two complete growing seasons to ensure reclamation success on problematic sites (e.g., close to livestock watering sources, erosive soils, etc.).
- Vehicles and equipment would be required to arrive at the work site clean, power-washed, and free of soil and vegetative debris capable of transporting weed seeds or other propagules.
- Site-specific ground surveys would be required to verify the existence of NWI-wetlands, in addition to determining if these features and other existing unmapped streams or wetlands would be considered potentially jurisdictional.

4.6.4 Residual Impacts

Residual impacts would include the loss of vegetation community diversity and species composition for the life of the Project. However, vegetation communities that would be disturbed are common and found in abundance throughout the Project Area. These communities would be reestablished following interim and final reclamation. In addition, residual impacts to wetland and riparian areas and special status species are not expected due to avoidance of these areas and mitigation measures to manage erosion and sedimentation.

4.7 FISH AND WILDLIFE, INCLUDING SPECIAL STATUS SPECIES

4.7.1 No Action Alternative

4.7.1.1 Wildlife Habitats

Under the No Action Alternative, eight horizontal oil and natural gas wells would be developed in the Project Area from two proposed and two existing well pads located on fee and state surface estate. Surface disturbance estimates to Terrestrial and Aquatic Crucial Habitat Priority Areas under the No Action

Alternative are presented in **Table 4.7.1.1-1**. The No Action Alternative would result in the direct, short-term loss of 20.7 acres that could serve as a crucial habitat priority area for terrestrial wildlife in the Project Area. No habitat loss would occur in aquatic crucial habitat priority areas or in the WGFD Terrestrial Conservation Area.

Table 4.7.1.1-1. Surface Disturbance to WGFD Habitat Priority Areas in the Project Area

Name	Acres in Project Area	Short-Term Surface Disturbance (acres)[1,]	Percent Loss of Habitat in Project Area
Terrestrial Crucial Habitat Priority Area			
Thunder Basin	8,856	20.7	0.2
Aquatic Crucial Habitat Priority Area			
Prairie Stream and Riparian Corridors	5,871	0	0

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.7.1.2 Big Game

Surface disturbance to each WGFD mapped big game habitat under the No Action Alternative is provided in **Table 4.7.1.2-1**. The increased potential for vehicle collisions with big game species would be greatest during the well drilling and completion phases, as these stages in development require the highest number of materials and personnel that need access to the site.

Table 4.7.1.2-1. Surface Disturbance to Big Game Ranges under the No Action Alternative

Name	Seasonal	Acres in Project Area	Short-Term Surface Disturbance (acres)[1]	Percent of Project Area
Pronghorn	Severe Winter Relief	2,470	11.5	0.5
	Winter/Year-long	2,039	0.0	0
	Year-long	19,775	82.3	0.4
Mule Deer	Winter/Year-long	8,531	29.0	0.3
	Year-long	15,753	64.8	0.4
White-tailed Deer	Year-long	1,812	0.0	0

Source: WGFD 2014a

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.7.1.3 Upland Game

The No Action Alternative would result in the loss of approximately 21.5 acres of habitat for upland game species that may utilize the Project Area. This loss of habitat, particularly the approximately 1,956 feet of new and upgraded access roads, would fragment upland game habitat and could increase the potential for vehicle collisions with individual animals.

4.7.1.4 Raptors

Implementation of the No Action would result in the direct loss of approximately 21.5 acres of habitat that could be utilized by raptors for breeding, nesting, and foraging. Two surveyed ferruginous hawk nesting locations are currently within 0.5 mile of the No Action Alternative's construction area. These nests could potentially be adversely affected by the No Action Alternative, but the level of impact, if any, would depend on the distance from disturbance, the presence or absence of topographical screening, and the activity of the nest. Review of aerial imagery and topography indicate these ferruginous hawk nests would not be obscured from construction and operational activities by topographical screening. However, EOG would not commence construction and drilling within the APD-required seasonal and spatial buffers applicable to occupied raptor nests within the Project Area and as such, impacts associated with nesting raptors are expected to be reduced under this alternative. Where construction or drilling are occurring early in the nesting season, raptors seeking nest sites may avoid nesting near ongoing oil and gas operations.

4.7.1.5 Migratory Birds

The No Action Alternative would result in the direct loss of approximately 21.5 acres of habitat that could be used for nesting and foraging by migratory birds.

4.7.1.6 Special Status Species

4.7.1.6.1 Greater Sage-grouse

The No Action Alternative would not result in the loss of any greater sage-grouse priority habitat. Surface disturbance under the No Action Alternative would fragment sagebrush stands and result in the direct loss of approximately 20.7 acres of sagebrush within greater sage-grouse general habitat. None of the proposed wells would occur within 4 miles of the Streckley Road greater sage-grouse lek. Additionally, all wells would utilize some of the required design features (RDFs) and Best Management Practices (BMPs) provided in the BLM's 2015 Greater Sage-Grouse RMP Amendment (BLM 2015). These measures include, but are not limited to, closed-loop drilling, consolidating well locations, the use of existing infrastructure, and remote well monitoring.

4.7.1.6.2 Black-tailed Prairie Dog

No direct impacts to black-tailed prairie dogs would be anticipated under the No Action Alternative, as no known colonies occur within the surface disturbance footprint of the proposed facilities. The reduced habitat connectivity and increased human presence within the Project Area could impact colonies located nearby to project facilities.

4.7.1.6.3 Northern River Otter

No direct impacts to the northern river otter would be anticipated under the No Action Alternative, as no stream habitat would be disturbed to construct project facilities. However, the development of eight new wells and their production equipment could increase the potential for a hazardous release within the Project Area.

4.7.1.6.4 Swift Fox

The No Action Alternative would result in the direct loss of approximately 21.5 acres of swift fox habitat within the Project Area.

4.7.1.6.5 Golden Eagle

Implementation of the No Action Alternative would result in the direct loss of approximately 21.5 acres of habitat that could be utilized by golden eagles for foraging. No known golden eagle nest occur within 0.5 miles of surface disturbance proposed under the No Action Alternative.

4.7.1.6.6 Western Burrowing Owl

No direct impacts to western burrowing owls would be anticipated under the No Action Alternative because no known black-tailed prairie dog colonies occur within the surface disturbance footprint of the proposed facilities. No known nests occur within 0.5 miles of surface disturbance proposed under the No Action Alternative.

4.7.1.6.7 Ferruginous Hawk

Implementation of the No Action Alternative would result in the direct loss of approximately 21.5 acres of habitat that could be utilized by ferruginous hawks for breeding, nesting, and foraging. Two ferruginous hawk nesting locations are within 0.5 miles of a No Action Alternative construction area. These nests are approximately 377 and 2,417 feet from a proposed access road and well pad, respectively.

Studies have found that ferruginous hawks are sensitive to disturbance during the breeding season (Olendorff 1973, Gilmer and Stewart 1983, Schmutz 1984, White and Thurow 1985, Bechard et al. 1990). Nests in proximity to disturbance have been shown to produce fewer young (Olendorff 1973, Blair 1978, White and Thurow 1985). Ferruginous hawks tend not to return to breed in territories where breeding attempts in previous years failed as a result of disturbance (White and Thurow 1985). Additionally, the presence of well pads and access roads, and their associated noise and human activity, could lower the use of these nesting locations by ferruginous hawks in future nesting seasons.

4.7.1.6.8 Bald Eagle

Implementation of the No Action Alternative would result in the direct loss of approximately 21.5 acres of habitat that could be utilized by bald eagles for foraging. No known bald eagle nest sites or roosting locations occur within 0.5 miles of a No Action Alternative construction area.

4.7.1.6.9 Loggerhead Shrike and Lewis's Woodpecker

The No Action Alternative would result in the loss of approximately 20.7 acres of sagebrush habitat. The removal of riparian woodland habitat would not be anticipated under the No Action Alternative, but disturbances adjacent to riparian habitats could indirectly impact loggerhead shrike and Lewis's woodpecker that nest along Antelope and Sand Creek.

4.7.1.6.10 BLM and USFS Sagebrush Bird Species

The extent of direct habitat loss under the No Action Alternative would be considered the approximately 20.7 acres of sagebrush habitat within the disturbance footprint of pads and access roads. Indirect impacts could include the avoidance of foraging and nesting habitats adjacent to disturbance areas and habitat

fragmentation. Impacts to sagebrush bird species would vary between species depending on the season of construction and the habitat disturbed, and how those factors coincide with the annual migration and nesting patterns of the species. If construction and drilling activity were conducted in the late fall, many of the migratory species would have left the Project Area for southern wintering grounds, and impacts related to well development would not be anticipated. If construction and drilling were to occur during the spring or summer months, they could discourage nesting pairs from establishing nests or cause environmental stress to nests nearby the proposed development.

4.7.1.6.11 BLM and USFS Grassland Bird Species

Under the No Action Alternative, approximately 0.04 acres of surface disturbance would occur within high probability mountain plover habitat and approximately 20.6 acres of surface disturbance would occur in medium probability mountain plover habitat. Indirect impacts to grassland bird species could include the avoidance of foraging and nesting habitats adjacent to disturbance areas and habitat fragmentation. Impacts to sagebrush bird species would vary between species depending on the season of construction and the habitat disturbed, and how those factors coincide with the annual migration and nesting patterns of the species. Similar to the indirect impacts described for the BLM and USFS Sagebrush Bird Species (**Section 4.7.1.6.10**), the level of potential impact to nesting birds would depend on the season of activity.

4.7.1.6.12 Northern Leopard Frog

The No Action Alternative would disturb approximately 21.5 acres of soils, which would be expected to have increased erosion rates for the life of the Project. Increased sedimentation rates into nearby aquatic habitats within and near the Project Area, could increase salinity and turbidity levels above background levels. The eight new wells and the associated tanks and production facilities would pose an increased risk accidental releases within the Project Area. If spills of hazardous spills were to migrate out of production locations and enter nearby watershed, there is a potential for these materials to migrate into aquatic habitats down-gradient from the Project Area. Any alterations to aquatic habitats such as increased salinity and turbidity or the introduction of hazardous materials, could decrease the habitat quality and reduce its capacity to support northern leopard frogs.

4.7.1.6.13 USFS Region 2 Sensitive Fish Species

The No Action Alternative would disturb approximately 21.5 acres of soils, which would be expected to have increased erosion rates for the life of the project. Increased sedimentation rates into nearby aquatic habitats within and near the Project Area, could increase salinity and turbidity levels above background levels. The eight new wells and the associated tanks and production facilities would pose an increased risk accidental releases within the Project Area. If spills of hazardous spills were to migrate out of production locations and enter nearby watershed, there is a potential for these materials to migrate into aquatic habitats down-gradient from the Project Area. Any alterations to aquatic habitats such as increased salinity and turbidity or the introduction of hazardous materials, could decrease the habitat quality and reduce its capacity to support sensitive fish species.

4.7.2 Proposed Action Alternative

4.7.2.1 Wildlife Habitats

Surface disturbance from the Proposed Action would increase habitat loss and fragmentation, as well as reduce habitat utilization in areas adjacent to disturbance, but these impacts would vary for each species depending on their sensitivity to human activity. The loss of WGFD Crucial Habitat Priority Areas would constitute a loss of habitat with significant regional value. These habitats could be important ecosystem components and house a diverse assemblage of wildlife. As such, the loss of these habitats could impact numerous species across grassland, sagebrush, and aquatic communities. Impacts to individual species of concern and regionally sensitive groups of animals are discussed in the following sections in this wildlife analysis. No WGFD Terrestrial Conservation Areas would be disturbed under the Proposed Action. The single corridor system would reduce the amount of habitat loss and fragmentation by centralizing pad locations and reducing the length of access roads needed for construction, drilling, and production. The Proposed Action would utilize interim reclamation to reduce the amount of habitat loss within the Project Area during the operation of the well pads. Final reclamation would restore all disturbed habitats to their natural contours and disturbance areas would be reseeded.

Implementation of the Proposed Action would result in 98.2 acres of surface disturbance of potential wildlife habitat within the Project Area. Surface disturbance to Terrestrial and Aquatic Crucial Priority areas under the Proposed Action is presented in **Table 4.7.2.1-1**.

Table 4.7.2.1-1. Surface Disturbance to WGFD Habitat Priority Areas in the Project Area

Name	Acres in Project Area	Short-Term Surface Disturbance (acres)[1]	Percent of Habitat in the Project Area
Terrestrial Crucial Habitat Priority Area			
Thunder Basin	8,856	46.3	0.5
Aquatic Crucial Habitat Priority Area			
Prairie Stream and Riparian Corridors	5,871	10.4	0.2

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.7.2.2 Big Game

Direct impacts to big game species would result from the loss of habitat and the increased potential for mortality from vehicle collisions. The clearing of vegetation and soils for the development of pads and access roads would result in the loss of WGFD crucial and substantial habitats for all big game species with a potential to inhabit the Project Area. Habitat loss would be greatest during the construction, drilling, and completion phases of well development, but would decrease during the production phase as interim reclamation would restore habitat.

Big game would likely be displaced from areas where project activities would occur (e.g., construction, drilling, traffic, etc.). Mineral drilling activities in Wyoming have been found to displace mule deer by more than 0.5 miles (Hiatt and Baker 1981). Mule deer also tend to select areas farther from well pads associated

with higher levels of traffic (Sawyer et al. 2009). Avoidance zones around well pads and access roads would likely overlap and create contiguous avoidance areas (WGFD 2004). A multi-year study on the Pinedale Anticline suggests not only did mule deer avoid mineral activities, but after three years of drilling activity the deer did not become accustomed to the disturbance (Madson 2005, Sawyer et al. 2006). The WGFD does not provide an impact rating based on well density for the habitat ranges present in the Project Area (WGFD 2010b).

The WGFD recognizes that pronghorn are much less sensitive to oil and gas development than mule deer. Like mule deer, the WGFD does not provide an impact rating based on well density for the habitat ranges present in the Project Area. The WGFD also does not provide an impact rating based on well density for white-tailed deer and no Rocky Mountain elk winter crucial range is present within the Project Area.

Indirect impacts in crucial winter and year-long habitats, such as avoidance of construction areas and human activity, would be greatest during the spring and winter. Canfield et al. (1999) found that forced activity resulting from human disturbance exacts an energetic disadvantage on the affected animals, while inactivity provides an energetic advantage for animals through conservation. Human disturbance can create a response that increases metabolism, which could result in illness, decreased reproductive fitness, and even death (Geist 1978). Similarly, springtime disturbance to big game from oil and gas activity may increase stress levels in reproductively active females using year-long habitat, with may result in reduced reproductive success.

Surface disturbance to each WGFD mapped big game habitat under the Proposed Action is provided in **Table 4.7.2.2-1**.

Table 4.7.2.2-1. Surface Disturbance to Big Game Ranges under the Proposed Action Alternative

Name	Seasonal	Acres in Project Area	Short-Term Surface Disturbance (acres)[1]	Percent of Range in the Project Area
Pronghorn	Severe Winter Relief	2,470	11.5	0.5
	Winter/Year-long	2,039	0.0	0.0
	Year-long	19,775	82.7	0.4
Mule Deer	Winter/Year-long	8,531	29.0	0.3
	Year-long	15,753	65.2	0.4
White-tailed Deer	Year-long	1,812	0.0	0.0

Source: WGFD 2014a

[1] Total acreage estimates in this table are based on GIS-software calculations and may not equal total acreage by well pad due to rounding, removal of overlapping development, and minute boundary discrepancies.

4.7.2.3 Upland Game

Oil and gas development within the Project Area would result in increased noise, human presence, and potential visual obstructions that could displace upland game from habitats near proposed well pad and access corridors. Avoidance of project related disturbance (e.g., equipment operation, vehicular traffic, and noise) would push upland game into other, adjacent habitats. These habitats could be less suitable or have

higher animal densities, which could lead to increased interspecific and intraspecific competition for resources. The magnitude of impacts to upland game and their habitats would depend on a number of factors, including the type and duration of disturbance, the species of upland game present, and time of year.

The Proposed Action would result in the loss of approximately 98.2 acres of habitat for upland game species that may utilize the Project Area. This loss of habitat, particularly the approximately 9,574 feet of new and upgraded access roads, would fragment upland game habitat and could increase the potential for vehicle collisions with individual animals.

4.7.2.4 Raptors

Impacts to raptors would result from the loss of prey habitat, fragmentation of existing contiguous habitats, avoidance of habitat adjacent to disturbance areas (due to human related visual and noise disturbances), and increased potential for vehicle collision. These impacts would vary depending on species-specific sensitivities to disturbance, the habitat types lost (e.g., breeding, nesting, or foraging), and seasonal timing of construction, drilling, and completion activities.

Surface disturbance would result in habitat loss for raptor prey species such as small mammals, reptiles, and birds. The loss or fragmentation of habitat for raptor prey species has been identified as a factor in raptor declines (Rodriguez-Estrella et. al. 1998). However, reclaimed foraging habitats would eventually promote a density and biomass of small mammals that is comparable to those of undisturbed areas (Hingtgen and Clark 1984). Following the construction, drilling, and completion phases of the Project, EOG would reclaim portions of the well pads not needed for well production, which would reduce the amount of long-term surface disturbance from the proposed alternatives. Once the production phase of the Project is completed, EOG would complete final reclamation which would restore all of the disturbed habitats for raptors and their prey species.

Project related activities in close proximity to active raptor nests could impact nest productivity. Romin and Muck (2002) indicate that activities within 0.5 mile of a nest are prone to cause adverse impacts to nesting raptors. If disturbances from oil and gas activity occur during nesting, they could be sufficient to cause adult birds to remain away from the nest and their chicks for the duration of the activities. This absence can lead to overheating or chilling of eggs or chicks. Prolonged disturbance during nesting can also lead to the abandonment of the nest by the adults. Both actions can result in egg or chick mortality.

As use of the Project Area by oil and gas workers increases, the potential for encounters between raptors and humans would also be expected to increase. Increased traffic would be expected to increase the potential for nest disturbances and abandonment, vehicle collisions, and poaching incidences along roadways. These impacts would be expected to be highest during the development phase of the project (i.e., during construction, drilling, and completion) and lowest during the production phase, when less visits to the Project Area would be required.

Implementation of the Proposed Action would result in the direct loss of approximately 98.2 acres of habitat that could be utilized by raptors for breeding, nesting, and foraging. Nineteen (11 ferruginous hawk, 3 red-tailed hawk, and 4 golden eagle, and 1 unknown species) surveyed nesting locations are currently within 0.5 mile of proposed construction areas. These nests occur within a range of 377 to 2,417 feet from the edge

of disturbance. These nests may have the potential to be adversely affected by the Proposed Action, but the level of impact, if any, would depend on the species, distance from disturbance, the presence or absence of topographical screening, and the activity of the nest. However, EOG would not engage in disruptive activities within seasonal and spatial buffers applicable to occupied raptor nests within the Project Area (**Section 2.2.8.5**). The number of nests that are located within 0.5 miles of a proposed disturbance for individual species of concern are provided in **Section 4.7.2.6.**

As discussed previously, mitigation measures such as the review, modification, and/or removal of sites with raptor conflicts during the onsite process (**Section 2.2.8.5**), interim reclamation, and adherence to BLM seasonal buffers would reduce impacts to raptors in the Project Area. Given the use of mitigation measures, impacts to raptors are expected to be minimal.

4.7.2.5 Migratory Birds

Various migratory bird species, including passerines, utilize the Project Area during their migratory cycle for foraging and nesting. Direct impacts to these species would come from the removal of vegetation and alteration of topography in areas that could be used for foraging and nesting. Indirect impacts could include the avoidance of foraging and nesting habitats adjacent to disturbance areas and habitat fragmentation. Impacts to migratory bird species would vary between species depending on the season of construction and the habitat disturbed. If construction and drilling activity were conducted in the late fall, many of the migratory species would have left the Project Area for southern wintering grounds, and impacts related to well development would not be anticipated. If construction and drilling were to occur during the spring or summer months, they could discourage nesting pairs from establishing nests or cause environmental stress to nests nearby the proposed development. No direct mortality from production equipment would be anticipated as EOG would utilize bird screens on all exhausts located on well pads (**Section 2.2.8.5**).

The introduction of new well pads and access roads to the Project Area would fragment previously contiguous habitat patches. Habitat fragmentation would result in more than just a quantitative loss in the total area of habitat available; the remaining habitat area would also be qualitatively altered (Temple and Wilcox 1986). Ingelfinger and Anderson (2004) identified that the density of breeding Brewer's sparrows declined by 36% and breeding sage sparrows declined by 57 percent within 100 meters of dirt roads in a natural gas field. As such, the greatest loss of habitat would be incurred by those species that are most "edge-sensitive".

No known nesting locations for migratory bird species would be directly impacted by the Proposed Action. The Proposed Action would result in the direct loss of approximately 98.2 acres of habitat that could be used for nesting and foraging by migratory birds.

4.7.2.6 Special Status Species

4.7.2.6.1 Greater Sage-grouse

Surface disturbance within the Project Area would result in the loss and fragmentation of sagebrush habitat that could be utilized by greater sage-grouse. Noise and human activity at along roads and at well pads during construction, drilling, and completion could be disruptive to sage-grouse occupying sagebrush habitats in the Project Area. Following the productive period of the project, all disturbance would be recontoured and revegetated and returned to use for sage-grouse individuals. It should be noted that while

interim and final reclamation would revegetate disturbance areas, it could take decades for areas containing sagebrush to return to their pre-disturbance conditions.

The Project Area is not within two miles of a known greater sage-grouse lek location and would therefore not be expected to exceed the WGFD disturbance threshold for sage-grouse or trigger any BLM CFO RMP development restrictions for sage-grouse. While no leks occur within the Project Area, there is a potential for greater sage-grouse to utilize the Project Area for nesting. Due to the proximity of the Streckley Road lek, which is 2.8 miles from the Project Area and was active in 2014, greater sage-grouse could nest near the Project Area and proposed development areas. However, as sage- grouse nest farther from disturbed leks (2.6 miles) than from undisturbed leks (1.3 miles) (Lyon and Anderson 2003), the potential for nesting within or directly adjacent to the Project Area is limited. If surface disturbance and well development activities were to occur near an active nesting site during breeding/nesting season (March 15 – June 30), the proposed Project could put additional stress on nesting sage-grouse.

An additional indirect impact to sage-grouse from the Proposed Action would be an increased potential for mortality from vehicle collision. New access roads could result in a potential increase in vehicle collisions on roads that would be constructed near sagebrush habitats.

The Proposed Action would not result in the loss of any greater sage-grouse priority habitat; the project is located within general habitat. Surface disturbance under the Proposed Action would fragment sagebrush stands and result in the direct loss of approximately 46.3 acres of sagebrush habitat. Three of the proposed wells on Blade 23 NWNW would be constructed within four miles of the Streckley Road greater sage-grouse lek. All proposed wells would comply with the RDFs and BMPs provided in the BLM's 2015 Greater Sage-Grouse RMP Amendment (BLM 2015). These measures include, but are not limited to, closed-loop drilling, consolidating well locations, the use of existing infrastructure, and remote well monitoring. Development under the Proposed Action would be in conformance with the BLM's 2015 Greater-Sage Grouse RMP Amendment (BLM 2015).

4.7.2.6.2 Black-tailed Prairie Dog

Surface disturbance within the Project Area would not result in the direct loss of occupied habitat or displace black-tailed prairie dogs. However, new access corridors could increase the potential for vehicle related mortality. Roads and well pads would also fragment habitat for prairie dogs within the Project Area, which could reduce the connectivity of metapopulations and further reduce the overall available habitat in the Project Area. Noise and human activity near an active prairie dog colony could result in stress related responses that could result in heightened activity and energy use by resident black-tailed prairie dogs. This could force colonies to move or shift and could expose individual prairie dogs to predator species.

No direct impact to black-tailed prairie dogs is anticipated under the Proposed Action, as no known colonies occur within the surface disturbance footprint of the proposed facilities. The reduced habitat connectivity and increased human presence within the Project Area could impact colonies located nearby project facilities.

4.7.2.6.3 Northern River Otter

No direct impact to the northern river otter is anticipated under the Proposed Action, as no stream habitat would be disturbed to construct project facilities. The development 47 new wells and their production

equipment would be expected to increase the potential for a hazardous release within the Project Area. Indirect impacts would be limited to the potential for releases of hazardous materials into the Antelope Creek Watershed. The increase in potential for an accidental release of hazardous material would be commensurate to the number of wells, production equipment, and storage tanks introduced to the Project Area. While the potential for a hazardous release into Project Area surface water features is possible, it would be minimized by the implementation of site specific SPCC plans. These plans would contain eroded soils and accidentally released materials on well pads and within access road ROWs, and would identify the proper procedures for cleanup, if necessary.

4.7.2.6.4 Swift Fox

The construction of the proposed pads and access roads would result direct habitat loss and disrupt foxes ability to forage, breed, raise young, or find adequate shelter. New roads and pad locations would fragment existing swift fox habitat within the Project Area. Constant noise, movement of equipment, and habitat alterations would exert additional stress on foxes that may use the Project Area and could result in a decrease in fox reproductive success. Project related traffic on new and existing access roads may result in swift fox road mortalities.

The Proposed Action would result in the direct loss of approximately 98.2 acres of potential swift fox habitat within the Project Area. No known swift fox burrows would be impacted by the Proposed Action.

4.7.2.6.5 Golden Eagle

Impacts to Golden Eagles would be identical to those described for raptors in **Section 4.7.2.4**. Eleven golden eagle nests are located within 0.5 miles of the Project Area. If construction were to occur within the USFWS 0.5-mile disturbance buffer for golden eagles during the nesting season, it could cause increased environmental stress levels on adult birds who may use the nests. This could result in decreased reproductive fitness for birds nesting in these locations.

The CFO RMP recommends implementing a 0.5-mile buffer around golden eagle nests from February 1 to July 31 in which no surface disturbance or well development would occur. These recommended buffers can be modified in coordination with the BLM based on local conditions, such as topography.

Implementation of the Proposed Action would result in the direct loss of approximately 98.2 acres of habitat that could be utilized by golden eagles for foraging. As discussed in **Section 2.2.8.5**, EOG and the BLM reviewed, modified, and/or removed some locations with the potential raptor conflicts. Four known golden eagle nests occur within 0.5 miles of surface disturbance proposed under the Proposed Action. These nests are found at distances ranging from 1,643 to 2,356 feet from the edge of proposed disturbance. None of these nests were active in 2015.

4.7.2.6.6 Western Burrowing Owl

No direct impacts to western burrowing owls would be anticipated under the Proposed Action because no known black-tailed prairie dog colonies occur within the surface disturbance footprint of the proposed facilities. However, noise and human activity associated with well operation and well development could prevent the future use of nesting and foraging habitat within the Project Area. Surface disturbance could also result in the direct loss of foraging habitat within the Project Area. Other indirect impacts would be identical to those described in the general analysis for raptors **Section 4.7.2.4**.

No known nests occur within 0.5 miles of surface disturbance proposed under the Proposed Action; therefore, no impacts to nesting owls would be anticipated.

4.7.2.6.7 Ferruginous Hawk

Impacts to ferruginous hawks would be similar in scope to those described for raptors in **Section 4.7.2.4**.

Studies have found that ferruginous hawks are sensitive to disturbance during the breeding season (Olendorff 1973, Gilmer and Stewart 1983, Schmutz 1984, White and Thurow 1985, Bechard et al. 1990). Nests in proximity to disturbance have been shown to produce fewer young (Olendorff 1973, Blair 1978, White and Thurow 1985). Ferruginous hawks tend not to return to breed in territories where breeding attempts in previous years failed as a result of disturbance (White and Thurow 1985). As such, if surface disturbance were to occur during the ferruginous hawk nesting season, Project activities could contribute to lowered productivity of active nesting locations. Additionally, the presence of well pads and access roads, and their associated noise and human activity, could lower the use of these nesting locations by ferruginous hawks in future nesting seasons.

The CFO RMP recommends implementing a 0.5 mile -buffer around ferruginous hawk nests from February 1 to July 31 in which no surface disturbance or well development would occur. These recommended buffers can be modified in coordination with the BLM based on local conditions, such as topography.

The Proposed Action would result in the direct loss of approximately 98.2 acres of habitat that could be utilized by ferruginous hawks for breeding, nesting, and foraging. As discussed in **Section 2.2.8.5**, EOG and the BLM reviewed, modified, and/or removed some locations with the potential raptor conflicts; however, eleven ferruginous hawk nests are within 0.5 miles of disturbance. Two of these nests were active in 2015 (HWA 2015c). These nests are found at distances ranging from 377 to 2,512 feet from the edge of disturbance.

4.7.2.6.8 Bald Eagle

Impacts to bald eagles from the Proposed Action would be identical in scope to those described under raptors in **Section 4.7.2.4**. While no winter roosts have been identified within the Project Area, human activities, traffic, and construction associated with the Proposed Action may displace eagles that may roost along Antelope Creek during the winter.

The Proposed Action would result in the direct loss of approximately 98.2 acres of habitat that could be utilized by bald eagles for foraging. No known bald eagle nest location occur within 0.5 miles of a Proposed Action construction area.

4.7.2.6.9 Loggerhead Shrike and Lewis's Woodpecker

Surface disturbance from the Proposed Action would remove and fragment existing nesting and foraging habitat for the loggerhead shrike and Lewis's woodpecker within the Project Area. Human activity and project-related noise along access roads and at well pads could result in the avoidance of adjacent riparian and shrubland habitats. Should construction, drilling, and completion occur during the breeding season, individuals utilizing the Project Area could abandon their nests and offspring, or experience lower productivity.

The Proposed Action would result in the loss of approximately 46.3 acres of sagebrush habitat. The removal of riparian woodland habitat is not anticipated under the Proposed Action, but disturbances adjacent to riparian habitats could indirectly impact loggerhead shrike and Lewis's woodpecker who nest along Antelope and Sand Creek.

4.7.2.6.10 BLM and USFS Sagebrush Bird Species

Direct and indirect impacts to the Brewer's sparrow, sage sparrow, and sage thrasher would be identical in scope to those described in **Section 4.7.2.5** for migratory bird species. The extent of direct habitat loss would be considered the approximately 46.3 acres of BLM-delineated sagebrush habitat within the disturbance footprint of the facilities planned under the Proposed Action. Should construction, drilling, and completion occur during the breeding season, individuals utilizing the Project Area could abandon their nests and offspring, or experience lower productivity.

4.7.2.6.11 BLM and USFS Grassland Bird Species

Direct and indirect impacts to the Baird's sparrow, grasshopper sparrow, McCown's longspur, chestnut-collared longspur, mountain plover, and long-billed curlew would be identical in scope to those described in **Section 4.7.2.5**. As the extent of grassland habitat within the Project Area has not been delineated, the extent of direct habitat loss within grasslands is not currently known.

As biological field surveys for mountain plovers have been conducted within the Project Area, the surface disturbance for this species can be quantified. Under the Proposed Action, approximately 32.2 acres of surface disturbance would occur within high probability mountain plover habitat, approximately 31.5 acres of surface disturbance within medium probability mountain plover habitat, and approximately 30.2 acres of surface disturbance would occur in low probability mountain plover habitat. The delineated mountain plover habitat would serve as a good approximation of the minimum disturbance to other grassland bird species habitat within the Project Area; however, it should be noted that habitat requirements would vary between sensitive grassland bird species. Interim reclamation would reduce the amount of surface disturbance present during the production phase of the Proposed Action. Final reclamation would be expected to restore habitat for mountain plovers within the Project Area to pre-disturbance levels. Should construction, drilling, and completion occur during the breeding season, individuals utilizing the Project Area could abandon their nests and offspring, or experience lower productivity.

4.7.2.6.12 Northern Leopard Frog

No direct habitat loss for the northern leopard frog would occur as no surface disturbance would occur within wetlands, marshes or perennial waters. Indirect impacts to northern leopard frog habitat could come from the deposition of material eroded from disturbance footprints and from the deposition of accidentally released hazardous material into Project Area surface water features. The degree of these impacts would be commensurate with the quantity of surface disturbance within the Project Area and the number of new wells, production equipment, and storage tanks. If sediments from Proposed Action well pads and access roads or accidentally leaked hazardous materials were to enter wetlands or waters within the Project Area, it would reduce the quality of available habitat for the northern leopard frog. The potential for these indirect impacts would be reduced through the development and implementation of site specific SWPPPs and SPCC plans. These plans would contain eroded soils and accidentally released materials on well pads and within access road ROWs, and would identify the proper procedures for cleanup, if necessary. Interim and final

reclamation would reduce the amount of disturbed soils within the Project Area, and both limit the increase in erosion during the production phase of the project and return disturbance areas to pre-disturbance erosion rates once wells are removed from production.

The Proposed Action would disturb approximately 98.2 acres of soils, which would be expected to have increased erosion rates for the life of the project. The 47 new wells and the associated tanks and production facilities would pose an increased risk accidental releases within the Project Area. The implementation of SPCC plans would reduce the potential for hazardous materials to reach wetlands, marshes, or perennial waters in the Project Area.

4.7.2.6.13 USFS Region 2 Sensitive Fish Species

Oil and gas activities within the Project Area would increase soil erosion as a result of clearing vegetation, increased soil exposure, and steepening of exposed soils in areas with cut and fill. Eroded soils could enter perennial streams, intermittent streams, or canals/ditches, which could be transported downstream to the Cheyenne River. The Proposed Action Alternative would also increase the risk for the potential exposure of aquatic habitats to hazardous material through an accidental release. Increased sediment loads and hazardous material releases in the Cheyenne River could degrade habitat for the mountain sucker, plains topminnow, plains minnow, and flathead chub. The potential for these indirect impacts would be reduced through the development and implementation of site specific SWPPPs and SPCC plans. These plans would contain eroded soils and accidentally released materials on well pads, and would identify the proper procedures for cleanup, if necessary. Interim and final reclamation would reduce the amount of disturbed soils within the Project Area, and both limit the increase in erosion during the production phase of the project and return disturbance areas to pre-disturbance erosion rates once wells are removed from production.

The Proposed Action would disturb approximately 98.2 acres of soils, which would be expected to have increased erosion rates for the life of the project. The 47 new wells and the associated tanks and production facilities would pose an increased risk accidental releases within the Project Area. The implementation of SWPPPs, SPCC plans, and reclamation activities would reduce the amount of sediment and potentially hazardous material from reaching intermittent streams, perennial streams, and canals/ditches in the Project Area.

4.7.3 Mitigation

Interim and final reclamation activities, in conjunction with ACEPMs (**Section 2.2.8.5**) and ongoing raptor surveys, would help to mitigate or reduce the impacts described above for all wildlife (particularly avian species), including special status species. Impacts to aquatic species would be minimized by the implementation of spill containment and cleanup procedures that would prevent hazardous waste from reaching drainages and surface water. In addition, erosion control measures, as outlined in SWPPPs, would minimize the amount of sediment from reaching drainages and surface water. The following mitigation measures would also be implemented:

- Prior to surface-disturbing activities within 0.5 mile of mapped potential greater sage-grouse habitat, a BLM-approved contractor would conduct clearance surveys using approved protocol to

detect breeding activity. If breeding activity is confirmed, development restrictions outlined in **Section 3.7.6.1.1** may be required.

- If case-by-case wildlife surveys for proposed disturbance indicate prairie dog burrows or potential burrowing owl nest sites, these areas would be avoided.

4.7.4 Residual Impacts

Residual impacts at well locations would be minimal based on design features, ACEPMs (**Section 2.2.8.5**) and mitigation. Avoidance behaviors may be exhibited by wildlife that inhabit or nest in areas near production facilities and roads. These impacts would be expected to last until final reclamation is successfully completed. Any unreclaimed roads would contribute to the existing fragmentation of habitat in the project vicinity.

4.8 CULTURAL RESOURCES

4.8.1 No Action Alternative

Under the No Action Alternative, oil and gas development in the Project Area would be limited to fee and state mineral estate, as the proposed Project would have no federal involvement. Although development of the eight proposed wells would not trigger the Section 106 process, as currently planned, the No Action Alternative would have no direct impacts on known cultural resources that were identified during the Class III Inventory (SWCA 2015). Other potential impacts to unknown cultural resources would be similar to those described in **Section 4.8.2**.

4.8.2 Proposed Action Alternative

Analysis of potential adverse effects to cultural resources considers both direct and indirect impacts. Cultural resources would be directly affected if damaged or destroyed by ground-disturbing activities such as well pad and facilities development, access road construction, and secondary surface activities (e.g. vehicular and pedestrian traffic). Direct impacts can be assessed by identifying the types and locations of proposed activities and determining the exact location of cultural resources that could be affected.

Cultural resources may also be subject to indirect effects, including an increased risk of vandalism, surface artifact collection, visual intrusion, and unauthorized excavation. Fugitive dust has the potential to affect cultural resources by coating artifacts, features, and rock art panels with dust. Typical dust suppression methods, including the application of water or chemical suppressants to unimproved roads, are generally sufficient to limit the distance dust travels from its point of origin. As such, those sites directly adjacent to roads or similar facilities would be most at risk.

One NRHP-eligible site (48CO3077) is located in the Project Area, but not within proposed disturbance areas associated with the Proposed Action. As currently planned, the Proposed Action Alternative would have no direct impacts on known cultural resources that were identified during the Class III Inventory (SWCA 2015).

All ground-disturbing activities associated with the Proposed Action would be consistent with the BLM manuals for cultural resources, National Programmatic Agreement (BLM 1997), State Protocol (BLM and

SHPO 2014), and Casper Field Office RMP (BLM 2007a). Therefore, with implementation of the ACEPMs identified in **Section 2.2.8.6** and the mitigation measures identified in **Section 4.8.3**, a finding of No Historic Properties Affected applies to the Proposed Action Alternative. Following the *State Protocol Between the Wyoming Bureau of Land Management State Director and The Wyoming State Historic Preservation Officer*, Section V(E)(iv), the Bureau of Land Management electronically notified the Wyoming State Historic Preservation Officer (SHPO) on 11/6/2015 that no historic properties exist within the area of potential effect.

4.8.3 Mitigation

The ACEPMs outlined in **Section 2.2.8.6** would help to mitigate or reduce the impacts described above for cultural resources, including the one NRHP eligible site (48CO3077). The following mitigation measures would be implemented to minimize potential impacts to cultural resources:

- Surface-disturbing activities associated with the Proposed Action would avoid cultural resource site 48CO3077.

4.8.4 Residual Impacts

With the incorporation of the specified mitigation measures outlined above, there would be little or no residual effects to cultural resources and would, therefore, not be significant.

4.9 LIVESTOCK GRAZING

4.9.1 No Action Alternative

Under the No Action Alternative, eight horizontal oil and natural gas wells would be developed in the Project Area from two proposed and two existing well pads located on fee and state surface estate. The No Action Alternative would result in the direct removal of approximately 21.5 acres of forage (or 1.3 AUMs) for livestock grazing operations on private and state lands in the Project Area. None of this surface disturbance would occur on the four federally managed grazing allotments in the Project Area, and therefore grazing on these allotments would continue in accordance with their respective grazing permits. Direct and indirect impacts to livestock grazing operations on the affected private and state lands would be expected to be similar, but less in extent to, those discussed for the Proposed Action in **Section 4.9.2**.

4.9.2 Proposed Action Alternative

Direct and indirect impacts on livestock grazing would include the following; the direct removal of forage for livestock grazing operations on private and state lands, the increased potential for disrupting livestock operations, increased oil and gas related traffic potentially leading to vehicle-livestock collisions, and decreased quality and quantity of forage due to the potential infestation of invasive and noxious weeds.

Loss of forage due to surface-disturbing activities would be the primary impact that would affect livestock grazing operations on private and state lands in the Project Area. Under the Proposed Action, no surface disturbance would occur on the four federally managed grazing allotments in the Project Area. However, approximately 98.2 acres of forage (or 4.9 AUMs) would be lost for livestock grazing operations on private and state lands.

The approximately 9,574 feet (1.8 miles) of new and upgraded access roads would increase the vehicular traffic within the Project Area. Increased vehicle traffic from construction and production activities could have a direct impact on livestock from deaths and injuries from vehicle-livestock collisions. The proposed access roads and upgrades would be built for the use of EOG employees, EOG contractors, and the land owner only. This increase in use would increase the potential for collisions and harassment of livestock. Additionally, livestock could be pushed away from preferred grazing areas and range improvements (e.g., water sources) by construction and production activities and traffic Also, improved access to water resources, could occur. As noted in **Section 2.2.8.7**, cattle guards would be installed at all fence crossings, unless requested otherwise by the landowner, to control livestock movement. The number of fence crossings needed to control livestock would likely increase with the increased level of project-related facilities and access roads. This increase, in tandem with the increased traffic levels, could increase the potential for gates to be left open and livestock to get of the allotment.

Implementation of the Proposed Action could increase the potential for or the introduction and/or spread of invasive and noxious weeds within the Project Area. Noxious weeds are generally unpalatable to livestock, and their establishment would result in the reduction of available forage. Following surface-disturbing activities, invasive and noxious weeds could spread and colonize areas that typically lack or have minimal vegetation cover or areas that have been recently disturbed.

The direct and indirect impacts described above have the potential to increase the grazing pressure on undisturbed lands in the Project Area. As disturbed portions become unavailable, the remaining areas could experience an increase in grazing pressure. Depending on the seasonal timing of the disturbances, the length of time disturbed areas are unavailable, and the current grazing management, the undisturbed portions of the allotments potentially could be over utilized, leading to degradation of the forage within the Project Area. Over utilization could also occur from uneven or undesired livestock distribution.

4.9.3 Mitigation

The Proposed Action was designed to reduce or minimize impacts to private grazing operations on private and state lands by design features, such as interim and final reclamation, and ACEPMs (**Section 2.2.8.4** and **Section 2.2.8.7**) that include provisions to control weeds and install cattle guards at all fence crossings, unless requested otherwise by the landowner. The use of cattle guards would minimize the increased potential for mortality and injuries to livestock resulting from increased vehicle traffic in the Project Area. Landowner specific mitigation measures for livestock and grazing are sometimes included in the respective SAA between EOG and the landowner. No additional mitigation is recommended.

4.9.4 Residual Impacts

As interim and final reclamation activities would restore livestock forage to its pre-disturbance production levels, residual effects to livestock grazing on private and state lands would be less than significant.

5.0 CUMULATIVE EFFECTS

CEQ regulations require an assessment of potential cumulative impacts. Cumulative impacts are defined as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable development (RFD) regardless of what agency or person undertakes such actions (40 CFR 1508.7). The cumulative impacts analysis was developed in consideration of past, present, and RFD activities that have occurred within approximately 15 years prior to the development of this EA, and approximately five years following the development of this EA.

The past, present, and RFD activities that have affected or may affect resources analyzed in this EA include, but are not limited to, ranching and mining operations, utilities, residential development, and oil and gas development. For oil and gas development, past activities include wells that are producing, plugged and abandoned, have been suspended, or have been shut-in. Present oil and gas activities include wells that are currently being drilled. Reasonably foreseeable oil and gas activities include wells that have approved APDs, but have not yet been constructed; wells that have approved APDs, but are waiting on additional regulatory approvals prior to construction; wells with applications that have not been issued APDs, and wells that are in the beginning stage of the permitting, planning, and/or NEPA process (e.g., the proposed oil and natural gas wells in the ongoing Greater Crossbow EIS). The primary reasonably foreseeable oil and gas project within the Cumulative Impacts Analysis Areas (CIAAs) for each resource is the Greater Crossbow Oil and Gas Project, for which an EIS was initiated on October 26, 2015 (80 FR 65242). This EIS will analyze the completion of up to 1,500 oil and gas wells from 100 Optimized Development Pads (ODP) and assesses the potential impacts related to the ancillary facilities such as access roads and utility corridors. The current planned completion date for the Greater Crossbow EIS is scheduled to be completed in the Fall of 2018.

Spatial boundaries and temporal timeframes for CIAAs can often vary by resource or issue. **Table 5.0-1** defines the CIAAs for each resource examined in this EA, and the rationale for these boundaries.

Table 5.0-1. Cumulative Impact Assessment Areas by Resource

Resource	Cumulative Impact Assessment Area	Rationale
Air Quality	Basin	Project activities would cumulatively contribute to changes in air quality within and immediately adjacent to the Project Area, and within the greater PRB.
Geologic Resources	Basin	PRB
Soils	Subwatersheds	Project activities impacting soils would only affect soil types present in the subwatersheds overlapping the Project Area, and would not cause additive effects to those occurring elsewhere.

Resource	Cumulative Impact Assessment Area	Rationale
Water Resources, Including Surface and Groundwater Quality, Floodplains, Hydrologic (Stormwater) Condition, and Waters of the US	Subwatersheds	Project activities impacting water resources would only affect those floodplains, wetlands, and waters of the United States that occur within the within and immediately downstream of the subwatersheds overlapping the Project Area, and would not cause additive effects to those occurring elsewhere.
Mineral Resources	Basin	PRB
Vegetation, Including Grassland and Shrubland Communities, Invasive and Nonnative Plant Species, Pest Control, and Special Status Species	Subwatersheds	Vegetation is closely tied to the soil and water resource characteristics unique to the subwatersheds overlapping the Project Area, which form a natural boundary for vegetative communities, and would not cause additive effects to those vegetation types occurring elsewhere.
Fish and Wildlife, Including Special Status Species	Subwatersheds	The habitat ranges for wildlife are unique to the individual species, and may vary in size between being fully encompassed by the Project Area to several times the size of the Project Area. For the purpose of this analysis, the CIAA for wildlife is assumed to be the subwatersheds overlapping the Project Area, which form a natural boundary for soil, water, and vegetative communities utilized by wildlife.
Cultural Resources	Project Area	Project activities impacting cultural resources would only affect those present in the Project Area and would not cause additive effects to those occurring elsewhere.
Livestock Grazing	Project Area and federal grazing allotments overlapping the Project Area	Project activities impacting agriculture and livestock would only affect those present within the boundaries of the Project Area and would not cause additive effects to those occurring elsewhere.

Potential cumulative impacts for each affected resource are assessed in this chapter. The discussion of potential cumulative impacts assumes the successful implementation of the environmental protection and mitigation measures described in **Chapter 4**, as well as compliance with the Casper RMP and applicable federal, state, and local regulations and permit requirements. Although much of the analyses focus on adverse cumulative impacts, it should be noted that cumulative impacts may also be beneficial. For example, there are significant positive cumulative economic effects of oil and gas development, including additional employment opportunities in the region and additional tax revenues to local governments.

5.1 AIR QUALITY

The CIAA for Air Quality is considered the PRB. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS and the Converse County EIS.

5.1.1 Criteria Pollutants, Ozone, Hazardous Air Pollutants, Other AQRVs

Cumulative air quality impacts are defined as the combination of emissions resulting from the No Action Alternative or Proposed Action, existing nearby permitted sources, and RFD within the region. The Greater Crossbow EIS, which is considered RFD within this CIAA, will include air quality monitoring through the development of an emissions inventory. Areas of concern include Prevention of Significant Deterioration Class I areas such as Washakie Wilderness Area and Fitzpatrick Wilderness Area and sensitive Class II areas. Potential AQRV impacts to sensitive areas include regional impacts on visibility, total nitrogen and sulfur deposition, and acid neutralization capacity.

As noted in the direct and indirect impacts section, emissions from the construction and development phases of the No Action Alternative or Proposed Action Alternative are temporary in nature and as a result would have minimal opportunity to combine with other emission sources for lasting local impacts, or any regional impacts. While emissions from the production phase of the project will be more consistent and longer term in nature, cumulative analyses of emissions are generally done for larger scale projects that could have potential for regional affect.

A review of other EAs produced by the Buffalo and Casper Field Offices (such as the Mohawk EA (BLM 2014c), and Mary's Draw EA (BLM 2013c)), show that an assumption has been made that actions that have a low probability of exceedences do not necessitate regional impact analyses.

For HAPs emissions, impacts are assessed on an incremental basis, not cumulative. This is due to the fact that HAP impacts are localized and the evaluation criteria are based on incremental effects, not cumulative.

Other AQRV's (as discussed in direct and indirect impacts) would be assessed for Class I areas for visibility and sensitive lakes analysis. The distance between the Project Area and the nearest Class I area (approximately 150 kilometers west of the Project Area) would make the potential for the No Action Alternative or Proposed Action Alternative to impact those areas very minimal.

5.1.2 Greenhouse Gas Emissions

Many elements of human society and the environment are sensitive to climate variability and change. Human health, agriculture, natural ecosystems, coastal areas, and heating and cooling requirements are examples of climate-sensitive systems.

The extent of climate change effects, and whether these effects prove harmful, will vary be region, over time, and based on the ability of different societal and environmental systems to scope with the change. According to the Intergovernmental Panel on Climate Change (IPCC) "Human interference with the climate system is occurring, and climate change poses risks for human and natural systems." (IPCC 2014).

Global temperatures are expected to continue to rise as human activities continue to add CO_2, CH_4, N_2O, and other greenhouse (or heat-trapping) gases to the atmosphere. Most of the United States is expected to experience an increase in average temperature (IPCC 2014). Precipitation changes, which are also very important to consider when assessing climate change affects, are more challenging to predict. Whether or not rainfall will increase or decrease remains difficult to project for specific regions.

Table 5.1.2-1 shows global and United States anthropogenic GHG emissions pertaining to global warming potential or carbon dioxide equivalents from 1970 through 2020. The United States data represents all GHGs and all anthropogenic sources of GHGs, but does not include sinks of GHGs. The emissions data were compiled from different sources of information that use different methodology and assumptions. As a result, data values for some of the years are not readily available for comparison.

Table 5.1.2-1. Global and United States GHG Emissions

Year	Global GHG Emissions[1] (million metric tons CO_2)	United States GHG Emissions[2] (million metric tons CO_2e)
1970	29,237	NA [3]
1980	37,390	NA [3]
1990	36,829	6,301
2000	39,002	7,213
2010	55,362	6,899
2013	59,026	6,673

[1] Source: Boden, TA, Marland, G, and Andres, RJ, 2013; Dlugokencky, E and Tans P, n.d.; and Houghton, RA, etal, 2012.
[2] Source: USEPA 2015d.
[3] NA = data not readily available from the sources cited.

5.2 GEOLOGIC RESOURCES

The CIAA for Geologic Resources is considered PRB. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS and the Converse County EIS.

5.2.1 Topography

The CIAA for geologic resources is considered the PRB. Existing disturbances to topography occur from oil and gas development, transportation development, mining, and urban development. Implementation of either alternative would increase the amount of disturbed earth within the Project Area, and reduce the amount of land with natural topographical features. While the Proposed Action and No Action Alternative would represent an incremental increase in altered topography within the CIAA, this disturbance would be temporary in nature as final reclamation would restore all cuts and fills to their natural contour.

5.2.2 Geologic Hazards

The CIAA for geologic resources is considered the PRB. Existing activities associated with geologic hazards occur from oil and gas development, transportation development, mining, and urban development. Neither the No Action Alternative nor Proposed Action Alternative is anticipated to increase the potential for geologic hazards within the CIAA.

5.3 SOILS

The CIAA for Soil resources is the extent of all of the USGS subwatersheds overlapping the Project Area. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS.

Existing oil and gas facilities, surface mining operations, and roadways have resulted in the removal, relocation, and redistribution of soil horizons within the CIAA. Soil disturbances are expected to continue as the existing petroleum recovery and surface mining operations continue to access their leased minerals underlying the Project Area. In addition to the existing and reasonably foreseeable development in the CIAA, the No Action Alternative and Proposed Action, if implemented, would increase disturbance to soil resources by 21.5 acres and 98.2 acres, respectively.

Activities that remove native vegetation and topsoil have the potential to increase erosion in disturbance footprints and sedimentation rates in the CIAA. Soil loss in the CIAA could reduce soil productivity and stability. This would be additive to the past, present, and reasonably foreseeable disturbances from oil and gas construction, road development, and surface mining operations. The incremental disturbance of the Proposed Action and No Action Alternative would reduce the CIAA's ability to effectively recycle nutrients and regulate water. The development of eight wells under the No Action Alternative and 47 wells under the Proposed Action would increase the potential for an accidental release of hazardous substances at well pads and along well pad access corridors. This would increase the risk of contamination of soils within the CIAA, which could result in a loss of soil productivity. These impacts would be localized to the site of the spill, but could spread outside the initial contamination area if a storm event occurs prior to remediation and cleanup activities. The implementation of site-specific SWPPPs and SPCC plans would reduce the incremental impact of the project on erosion rates and contamination risk within the CIAA. Additionally, ACEPMs in **Section 2.2.8.2** would reduce soil loss impacts during development in the CIAA.

5.4 WATER RESOURCES, INCLUDING SURFACE AND GROUNDWATER QUALITY, HYDROLOGIC (STORMWATER) CONDITION, FLOODPLAINS, AND WATERS OF THE UNITED STATES

The CIAA for Water Resources is the extent of all of the USGS subwatersheds overlapping the Project Area. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS.

5.4.1 Surface Water Resources

Existing oil and gas facilities, surface mining operations, and roadways are areas devoid of vegetation and are therefore subject to increased susceptibility to wind and water erosion, which could be deposited into surface water resources within the CIAA as sediment. The 21.5 acres and 98.2 acres of surface disturbance proposed under the No Action Alternative and Proposed Action, respectively, would further increase the quantity of exposed soils in the CIAA. Impacts on the Antelope Creek watershed from increased sediment loads could clog stream channels, degrade aquatic habitat (e.g. reduce photosynthetic activity, bury habitat,

and reduce food availability), and act as carrier of other pollutants such as metals, organic matter, phosphorus, and nitrogen (USEPA 2009).

The development of eight wells under the No Action Alternative and 47 wells under the Proposed Action would increase the potential for an accidental release of hazardous substances at well pads and along well pad access corridors. A release of hazardous materials at proposed facilities would have the potential to migrate into surface water resources through storm water runoff or through overland flow. These spills could increase toxic chemical content in Antelope Creek, Bates Creek, Sand Creek, and associated tributaries, reduce aquatic habitat quality, and potentially lead to mortality of aquatic species. The increased impacts to water quality from an incremental increase in risk of chemical or hydrocarbon release would be additive to the background risk presented form existing petroleum recovery development and surface mining operations.

Site-specific SWPPPs and SPCC plans would reduce the incremental impact of the project on surface water resources by designing site specific measures to limit the amount of eroded material and potentially released substances from leaving project facilities and entering the watershed.

5.4.2 Groundwater Resources

While eight wells under the No Action Alternative and 47 wells under the Proposed Action would likely be drilled through aquifers underlying the CIAA, impacts to these aquifers are not anticipated as the target formations would be far below any potable water sources. The implementation of a casing and cementing program would also limit the potential for communication between target formations and aquifers underlying the CIAA. As such, no incremental impact to groundwater quality it anticipated under either alternative.

Each well under the Proposed Action or No Action Alternative require approximately 153,500 to 303,500 bbl of groundwater to drill and complete each well. Withdrawals of water for drilling would result in the drawdown of groundwater from regional aquifers. The annual drawdown would be dependent on the number of wells drilled in a given year, but would be additive to the groundwater drawdown from other wells in the CIAA that withdraw water for livestock or mineral recovery operations.

5.4.3 Hydrologic (Storm Water) Conditions

The 21.5 acres and 98.2 acres of vegetation removal and topsoil disturbance proposed under the No Action Alternative and Proposed Action, respectively, would increase the amount of exposed soils within the CIAA. These exposed soil areas would be subject to an increased susceptibility to wind and water erosion during a storm event, which would increase the amount of sediment being collected in Antelope Creek during and after storm events. This would be additive to the lands that are currently cleared form surface mining, local roadways, and recent grazing activity. As well pads and roads would be engineered and constructed to minimize the suspended solid concentration of surface runoff, avoid disruption of drainages, and minimize direct impacts to surface water, the incremental impact of the proposed project is expected to be minimal.

5.4.4 Floodplains and Waters of the U.S.

The No Action Alternative and Proposed Action would not affect FEMA-mapped 100-year floodplains. However, implementation of the Proposed Action would disrupt approximately 1,201 linear feet of intermittent streams within the CIAA, which could alter flows and directly increase sediment loads within a tributary to Antelope Creek. Cumulative impacts associated with increased sedimentation and hazardous material release risk into surface water resources within the CIAA can be found in **Section 5.4.1**. No incremental impact to Waters of the U.S. would be expected under the No Action Alternative.

5.5 MINERAL RESOURCES

The CIAA for Air Quality is considered PRB. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS and the Converse County EIS.

5.5.1 Locatable Minerals

The CIAA for mineral resources is considered the PRB. Existing activities that are known to impact the quantity and availability of locatable minerals include oil and gas development, transportation development, mining, and urban development. Implementation of the No Action Alternative and/or the Proposed Action would reduce the amount of accessible locatable minerals within the CIAA as the quantity of surface disturbance would increase by 21.5 and 98.2 acres, respectively. The reduction in available lands for locatable mineral extraction would be reduced during the life of the project, but the quantity of locatable minerals within the CIAA is not expected to decrease as a result of either alternative. Although, the presence of well casings could limit the access to mineral resources in their direct proximity. As no locatable mineral development is going on within the Project Area, the proposed project is not anticipated to impact existing locatable mineral production within the PRB.

5.5.2 Leasable Minerals

The CIAA for mineral resources is considered the PRB. Existing activities that are known to impact the quantity and availability of leasable mineral resources include oil and gas development, transportation development, mining, and urban development. The eight and 47 wells proposed under the No Action Alternative and the Proposed Action, respectively would increase the annual production of oil and natural gas within the CIAA and result in a loss of oil and natural gas reserves within the CIAA. Oil production within the PRB was estimated at 41,217,626 bbl during 2014 (WOGCC 2015b). The anticipated annual production of the No Action Alternative and the Proposed Action, calculated by dividing the total production by the average life of each well, would be 73,493 and 431,773 bbl, respectively. As such the No Action Alternative and the Proposed Action would increase production in the CIAA by 0.17 and 1.05 percent, respectively. This increased production would reduce the amount of recoverable oil and natural gas resources within the CIAA.

Neither of the alternatives would be expected to impact coal production within the CIAA. While the proposed disturbances occur in the vicinity of an active mining site, development under either alternative would not interfere with any active coal leases. The development of wells under both alternatives would

reduce the amount of land available for coal leasing, this impact would be temporary. Oil and natural gas recovery would not reduce coal reserves within the CIAA.

5.6 VEGETATION, INCLUDING GRASSLAND AND SHRUBLAND COMMUNITIES, RIPARIAN AND WETLAND COMMUNITIES, INVASIVE AND NONNATIVE PLANT SPECIES, PEST CONTROL, AND SPECIAL STATUS SPECIES

The CIAA for vegetation is the extent of all of the USGS subwatersheds overlapping the Project Area. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS.

5.6.1 General Vegetation, Including Grassland, Shrubland, Riparian, and Wetland Communities

Existing oil and gas facilities, surface mining operations, and roadways have removed and fragmented native vegetation within the CIAA. The loss of vegetation would be expected to continue as the existing petroleum recovery and surface mining operations continue to access their leased minerals underlying the Project Area. Grazing operations would continue to disturb vegetation communities. In addition to the existing and reasonably foreseeable development in the CIAA, the No Action Alternative and Proposed Action, if implemented, would increase disturbance to vegetation by 21.5 acres and 98.2 acres, respectively. Neither of these alternatives would incrementally affect NWI wetlands.

Implementation of the proposed alternatives would also increase the potential for the trampling of vegetation, topsoil erosion, and risk of wildfire. While the trampling of vegetation and topsoil loss would only impact areas adjacent to the proposed disturbance, the increased potential for wild fire from oil and gas operations could spread to other areas within the CIAA. The incremental impact of vegetation and topsoil loss within the Project Area would remain until interim and final reclamation have revegetated all disturbance areas.

5.6.2 Invasive and Nonnative Plant Species and Pest Control

Adverse cumulative impacts that could occur from the introduction and spread of invasive and noxious weed species would include the reduction in the overall visual character of the area, increased soil erosion, a reduction in the quality and continuity of forage, and the supplanting native plant species. The additive impacts of the proposed alternatives when combined with other land uses, could increase the proliferation of weed infestations in the CIAA. Existing and new roadways may serve as a vector for spread of noxious species between currently infested areas into currently natural areas (Gelbard and Belnap 2003). The application of weed treatment during operation and the implementation of interim and final reclamation efforts would reduce any impacts associated with weed species within the CIAA.

5.6.3 Special Status Plant Species

5.6.3.1 Ute Ladies'-Tresses

Neither implementation of the No Action Alternative or Proposed Action would result in the direct loss of marginally suitable habitat for the Ute ladies'-tresses. As such, when assessed with other disturbances along

riparian habitat, such as active grazing and transportation corridors, the No Action Alternative and Proposed Action would not reduce the amount of marginal suitable habitat for Ute ladies'-tresses within the CIAA. However, the potential introduction and spread of noxious weeds along proposed and existing roadways could degrade marginal suitable habitats for Ute ladies'-tresses within the CIAA.

Additionally, surface-disturbing activities would cumulatively and incrementally increase soil erosion and sedimentation, soil compaction, and fugitive dust, which could alter the surrounding landscape and impact nearby wetland and riparian areas.

Based on direct and indirect cumulative impacts, ongoing and future well development and other land uses in the CIAA could cumulatively and incrementally reduce the ability of habitats in the CIAA to support Ute ladies'-tresses at their current or potential levels for the lifetime of oil and gas development and production. The cumulative effects determination would be the same those listed in the Chapter 4 impact analyses (**Section 4.6.2.3**).

5.6.3.2 Barr's Milkvetch

Approximately 20.7 and 56.5 acres of Barr's milkvetch habitat would be disturbed under the No Action Alternative and Proposed Action, respectively. This would be an incremental increase in habitat loss within the CIAA when added to existing land uses such as surface mining, oil and gas development, and transportation corridors. Indirect impacts to Barr's milkvetch would be similar to those described above for Ute ladies-tresses (**Section 5.6.3.1**). As such, the Proposed Action or No Action Alternative may affect individual Barr's milkvetch and their habitat in the CIAA, but would not likely lead towards federal listing of the species.

5.7 FISH AND WILDLIFE, INCLUDING SPECIAL STATUS SPECIES

The CIAA for Fish and Wildlife Resources is the extent of all of the USGS subwatersheds overlapping the Project Area. Past, present, and RFD activities within the CIAA include grazing, transportation development, urban development, coal mining, and oil and gas development. Large scale reasonable foreseeable activities planned within the CIAA include the Greater Crossbow EIS.

5.7.1 Wildlife Habitats

Existing oil and gas, mining, and livestock operations have reduced the amount of available habitat for wildlife within the CIAA. Additionally, the installation and operation of existing access roads, transportation corridors, and livestock fencing fragment the existing habitat within the CIAA making a less contiguous landscape that reduces habitat availability and connectivity. Implementation of the No Action Alternative and the Proposed Action, in conjunction with the Greater Crossbow Project would continue to reduce the size and availability of habitats to wildlife within the CIAA.

While the proposed alternatives would incrementally increase the amount of habitat disturbance and fragmentation within the CIAA as part of the Greater Crossbow Project, EOG is utilizing strategies to reduce the amount of surface disturbance and road construction. EOG's development approach for the Crossbow Area would utilize directional drilling and horizontal reaches to centralize well heads onto multi

well pads. The use of these multi-will pads allows EOG to minimize the amount of access roads required to access all of the wells field-wide.

5.7.2 Big Game

Increasing the acreage of surface disturbance within the CIAA under both alternatives would continue to reduce, both directly and indirectly, the available habitat for big game species. The construction and use of the roads within the CIAA, in conjunction with the existing road traffic and road infrastructure would fragment the available habitat for big game and serves as a barrier for migration from one patch to the other. The increased traffic as part of construction, well development, and well field operation would increase the potential for vehicle collisions with big game in the CIAA. The use of these multi-will pads allows EOG to minimize the amount of access roads required to access all of the wells field-wide and allows EOG to locate all of the proposed pads along a central corridor. This would minimize EOG's potential impacts to big game in the CIAA by reducing habitat fragmentation and the potential for vehicle collision.

The addition of well pads to the Project Area under the Proposed Action could increase the well pad density in some areas to three well pads per square mile when assessed with existing well pad infrastructure. One such area is located along Sand Creek. However, as disturbance from either alternative does not occur within crucial winter ranges for any big game species, the proposed project is not anticipated to raise WGFD impact ratings (WGFD 2010).

5.7.3 Upland Game

Cumulative impacts to upland game in the CIAA would result from increased habitat loss and fragmentation due to road and well site construction, increased traffic and associated noise, increase noise from well pads, and increased human activity near access roads and the proposed facilities. Continued oil and gas development in the CIAA could result in the direct loss, and indirect loss from fragmentation, of native habitats used by upland game. EOG's use of multi-will pads and horizontal wells allows EOG to minimize the amount of access roads required to access all of the wells field-wide. This would reduce EOG's incremental impact to habitat loss and fragmentation within the CIAA.

5.7.4 Raptors

Impacts to raptors from existing and planned development activities within the CIAA include disturbance to nesting raptors, degradation or destruction of nesting and prey habitats, raptor collisions with power lines, electrocutions from power equipment, and vehicular collisions with raptors feeding on carrion. No power lines would be constructed as part of either alternative and would not immediately contribute to the quantity of power lines in the CIAA. While the proposed alternatives are not anticipated to directly impact any nesting raptors, the installation of oil and gas facilities and roads would reduce the amount of nesting habitat available for resident and migrant raptors species within the CIAA. Implementation of interim and final reclamation would restore the landscape to its original contour and vegetative cover, which would return nesting and prey habitat to the CIAA. The length of time required for final reclamation to restore nesting and prey habitats would depend on the type of vegetation being reseeded. Some areas, such as sagebrush stands, would take decades to return to pre-disturbance composition.

5.7.5 Migratory Birds

Evaluating the cumulative impacts of past, on-going, and reasonably foreseeable activities is difficult because of the general lack of data on migratory birds in the Project Area and the range of effects that would occur in varying degrees to various species. It is assumed that the impacts identified in **Section 4.7.2** would be applicable to the cumulative impacts analysis would encompass the range of impacts from past, on-going, and reasonably foreseeable activities, but the magnitude of each impacts would vary from species to species depending on each species specific life history characteristics. The implementation of closed-loop drilling under both alternatives would remove any incremental impacts associated with open mining and mineral development pits within the CIAA.

5.7.6 Special Status Species

5.7.6.1 Greater Sage-grouse

West Nile virus (WNv) is also contributing to the decline of greater sage-grouse within the CIAA. The PRB FEIS (BLM 2003) states that "the synergistic effect of several impacts would likely result in a downward trend for the sage-grouse population, and may contribute to the array of cumulative effects that may lead to its federal listing. Local populations may be extirpated in areas of concentrated development, but viability across the Project Area [PRB] or the entire range of the species is not likely to be compromised (pg. 4-270)." Based on the impacts analysis PRB FEIS and the findings of more recent research, the Proposed Action could contribute to a decline in lek attendance at the Streckley Road lek that occurs within four miles of the Project Area, and, potentially, extirpation of the local grouse population.

There are approximately 20 existing wells within 4 miles of the Streckley Road lek. The Proposed Action would increase the number of wells in the 4-mile buffer by three. The No Action would not add any new wells within the 4-mile buffer of this lek. With the addition of the proposed wells, the well density within 4 miles of the leks increases to 0.46 wells per square mile, which is 46 percent of the 1 well per square mile recommendation given by the State Wildlife Agencies' Ad Hoc Committee for Sage-Grouse and Oil and Gas Development. While the well density for this lek would remain below the level of impact set by the State Wildlife Agencies, it is expected to increase if the reasonably foreseeable Greater Crossbow Project were to receive approval within the CIAA.

The proposed alternatives would reduce the amount of available sagebrush habitat within the CIAA. While this effect would reduce the amount of habitat for the greater sage-grouse, it would occur in the vicinity of an existing road corridor in areas where greater sage-grouse are likely to avoid. Interim and final reclamation would be expected to restore vegetation within the Project Area, which could take decades to full recover for and be suitable for sage-grouse.

Studies have observed the additive impact of energy development and WNv as a threat to greater sage-grouse persistence in the PRB (Taylor et al. 2012, Garton et al. 2011). These studies have primarily focused on CBNG development and the surface disposal of produced water. The cumulative effects of energy development and WNv in the PRB is expected to continue to impact the resident GSG populations, which would result further declines in lek attendance, and could result in local extirpation: "[f]indings reflect the status of a small remaining sage-grouse population that has already experienced an 82 percent decline within the expansive energy fields." (Taylor et al. 2012). One WNv outbreak year could reduce a sage-

grouse population by half. Without a stochastic population event, such as a WNv outbreak, and immediate extirpation is considered unlikely. However, observations suggest that if current oil and gas development trends within the PRB continue, the future viability of the northeastern Wyoming greater sage-grouse population could be compromised, with an increased chance of extirpation with additional WNv outbreaks (Taylor et al. 2012). Implementation of design features such as consolidation of well facilities onto multi-well pads and avoidance of sage-grouse leks would help to reduce the incremental impact of the proposed project on increasing the threat of WNv in the CIAA.

5.7.6.2 Black-tailed Prairie Dog

Existing oil and gas infrastructure and transportation corridors currently fragment the CIAA that increase the potential for vehicle related mortality of prairie dogs and serve as a barrier to migration and population communication. The proposed alternatives would increase the density of roads within the CIAA, which would further contribute to mortality rates and population isolation. Increased stress on the regional population of black-tailed prairie dog from the proposed alternatives could result in increased effectiveness of an outbreak of sylvatic plague, if one were to occur.

These impacts would likely impact local populations until the wells are removed from production and final reclamation has restored the pre-disturbance habitat and connectivity.

5.7.6.3 Northern River Otter

Both mineral development and the construction and use of transportation corridors has increased runoff into Antelope Creek and increased the risk for an accidental release of hazardous materials. The development of eight and 47 new wells under the No Action Alternative and Proposed Action, respectively, would incrementally increase the quantity of hydrocarbons recovered and stored within the Project Area. This increase in hydrocarbon recovery and storage is part of the greater Crossbow Project which would continue to discover and explore oil and natural gas resources underlying the CIAA. All these transportation and hydrocarbon recovery activities would continue to pose a risk of an accidental release of hydrocarbon materials into the Antelope Creek watershed, which would reduce the quality of habitat for the northern river otter and could pose as a health risk to otters if directly exposed to released materials.

5.7.6.4 Swift Fox

Given the primary impacts to the swift fox would come from the direct and indirect loss of potential habitat, cumulative impacts to this species would be identical to those described in **Section 4.7.2.1**. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitats to their pre-disturbance composition.

5.7.6.5 Golden Eagle

Cumulative impacts to golden eagles would be identical to those described in **Section 4.7.2.4** for raptors in general. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, adhering to BLM seasonal timing and spatial buffers, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.6 Western Burrowing Owl

Cumulative impacts to burrowing owl would be identical to those described in **Section 4.7.2.4** for raptors in general. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, adhering to BLM seasonal timing and spatial buffers, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.7 Ferruginous Hawk

Cumulative impacts to ferruginous hawks would be identical to those described in **Section 4.7.2.4** for raptors in general. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, adhering to BLM seasonal timing and spatial buffers, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.8 Bald Eagle

Cumulative impacts to bald eagles would be identical to those described in **Section 4.7.2.4** for raptors in general. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, adhering to BLM seasonal timing and spatial buffers, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.9 Loggerhead Shrike and Lewis's Woodpecker

Cumulative impacts to the loggerhead shrike and Lewis's woodpecker would be identical to those described in **Section 4.7.2.5** for migratory bird species. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, conducting pre-construction survey for nesting migratory birds, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.10 BLM and USFS Sagebrush Bird Species

Cumulative impacts to the BLM and USFS sagebrush bird species would be identical to those described in **Section 4.7.2.5** for migratory bird species. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, conducting pre-construction survey for nesting migratory birds, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.11 BLM and USFS Grassland Bird Species

Cumulative impacts to the BLM and USFS grassland bird species would be identical to those described in **Section 4.7.2.5** for migratory bird species. When these impacts are analyzed in conjunction with the impacts from past, present, and RFD within the CIAA, they would provide an incremental increase in nesting and prey habitat loss, habitat fragmentation, the potential for vehicle collision, and indirect habitat loss from auditory and visual disturbance. These incremental impacts from the No Action or Proposed Action would be minimized through consolidating well locations onto multi-well pads, conducting pre-construction survey for nesting migratory birds, and interim reclamation. The incremental impact from the proposed project would remain until final reclamation has restored habitat in the CIAA to their pre-disturbance composition.

5.7.6.12 Northern Leopard Frog

Neither alternative would incrementally contribute to the direct loss of habitat for northern leopard frogs in the CIAA. The incremental increase of surface disturbance, when added to existing and reasonably foreseeable disturbance would increase the amount of erosion within the CIAA. Eroded soils could migrate into Project Area wetlands and streams, which could increase the salinity and turbidity of these waters (EPA 2009), which could reduce the habitat value for northern leopard frogs.

5.7.6.13 USFS Region 2 Fish Species

The incremental increase of surface disturbance, when added to existing and reasonably foreseeable disturbance would increase the amount of erosion within the CIAA. Eroded soils could migrate into Project Area wetlands and streams, which could increase the salinity and turbidity of these waters (USEPA 2009), and could reduce the habitat value for sensitive fish species.

Both mineral development and the construction and use of transportation corridors has increased runoff into Antelope Creek and increased the risk for an accidental release of hazardous materials. The development of eight and 47 new wells under the No Action Alternative and Proposed Action, respectively, would incrementally increase the quantity of hydrocarbons recovered and stored within the Project Area. This increase in hydrocarbon recovery and storage is part of the Greater Crossbow Project which would continue to recover and explore oil and natural gas resources underlying the CIAA. All these transportation and hydrocarbon recovery activities would continue to pose a risk of an accidental release of hydrocarbon materials into the Antelope Creek watershed, which would reduce the quality of habitat for the sensitive fish species and could pose as a health risk individuals if directly exposed to released materials.

5.8 CULTURAL RESOURCES

The CIAA for cultural resources is the boundary of the Project Area, since impacts to cultural resources are not additive across a landscape. Impacts to cultural resources in the CIAA from past, present, or reasonably foreseeable future actions would primarily result from activities associated with surface and subsurface disturbance, though impacts could also result from non-surface disturbing activities that create atmospheric, visual, and/or auditory effects. These latter impacts would apply to sites or locations that together comprise the overall cultural experience for all visitors to the area, and would especially affect those deemed sacred or traditionally important by Native American Tribes or used by these groups in such a manner that atmospheric changes, visual obstructions, and/or noise levels impinge upon that use. These types of impacts cumulatively affect not only the historic setting, feeling, and viewshed of cultural resources, but also their eligibility potential for nomination to the NRHP.

Since no adverse effects to cultural resources are anticipated under either the Proposed Action or No Action Alternative, there would be no incremental loss of cultural resources. Therefore, neither alternative would appreciably alter the cumulative impacts to cultural resources in the CIAA.

5.9 LIVESTOCK GRAZING

The CIAA for livestock and grazing is considered the Project Area and the extent of all federal grazing allotments within the Project Area as project related activity would only impact livestock operations present within the boundaries of the Project Area and would not cause an additive effects to those occurring elsewhere. Existing activities within the CIAA include mining operations, oil and gas development, and private and public livestock grazing. Cumulative impacts to range resources from the proposed project would primarily come from the disturbance and fragmentation of existing grazing units. This would result in the reduction of available forage (i.e. AUMs) within these units and reducing their overall carrying capacity. Implementation of the No Action Alternative and/or the Proposed Action would incrementally increase the surface disturbance within rangelands by 21.5 and 98.2 acres, respectively. The No Action Alternative and Proposed Action Alternative would incrementally disturb grazing operations on private and

state lands. The No Action Alternative and Proposed Action Alternative would have no incremental impact to federal grazing allotments.

Increased access road development in the CIAA could incrementally and cumulatively contribute to difficulties in managing and moving livestock as roads could serve as a barrier to movement and more livestock could use roads as travel routes. Range facilities, such as water sources, fences, cattle guards, and corrals, could be damaged as a result of oil and gas construction and operation activities within the CIAA. However, development could result in benefits to grazing units as roads can assist in moving cattle from one allotment to another and may allow cattle to access portions of an allotment that were previously inaccessible due to geographic limitations. Increased vehicle traffic may increase the probability and occurrence of vehicle-cattle collisions. As discussed in **Section 4.6.2.2** access roads could serve as a preferential pathway for the introduction of noxious weeds in previously uninfected areas, which would further reduce the quality and quantity of available forage within the Project Area Other impacts to range resources that may cumulatively affect livestock within the CIAA include altered overland flow to livestock ponds from construction activities and stormwater BMPs, as well as increased displacement around disturbance areas resulting from vegetation loss, human activity, and traffic.

Impacts from the proposed project within the CIAA would be expected to last until final reclamation when disturbance areas are recontoured and reseeded. Once final reclamation is deemed successful, the CIAA would be expected to return to its pre-disturbance levels.

6.0 CONSULTATION AND COORDINATION

6.1 INTRODUCTION

Internal scoping was performed with an interdisciplinary team of specialists from the BFO and EOG environmental consultants. Resources identified during the internal scoping process were discussed in **Chapter 3**, *Affected Environment*, and impacts to those resources were disclosed in **Chapter 4**, *Environmental Effects* and **Chapter 5**, *Cumulative Effects*. Those resources not carried forward for analysis and the rational is documented in the Affected Resources Checklist included in **Appendix A**.

6.2 PERSONS, GROUPS, AND AGENCIES CONSULTED

The Proposed Action and No Action Alternative were discussed between EOG representatives, staff members and resource specialists from the BFO, and representatives from Kleinfelder, the third-party contractor for the preparation of the EA. Due to the similar nature, scope, scale, and location of the EA to other analyzed federal actions, it is expected that this Project would result in similar issues and comments, so external scoping was not conducted.

The BLM posted the 47 proposed APDs on the BFO website on April 23, 2015, thus initiating a 30-day public comment period for the Project. No comments were received.

6.3 LIST OF PREPARERS

Table 6.3-1 identifies the personnel responsible for the preparation of this EA.

Table 6.3-1. List of EA Preparers

Name	Agency/Firm	Title/Role
Ashley L. Smith	Kleinfelder, Inc.	NEPA Project Manager/Technical Review
Karen Simpson	Kleinfelder, Inc.	Quality Reviewer
Melissa Bridendall	Kleinfelder, Inc.	Assistant Project Manager/Document Preparation
Dustin Collins	Kleinfelder, Inc.	Resource Specialist/Air Quality/Quality Reviewer for Air Quality
Michele Steyskal	Kleinfelder, Inc.	Resource Specialist/Air Quality
Cale Wharry	Kleinfelder, Inc.	Resource Specialist/Geologic Resources; Mineral Resources; and Fish and Wildlife, Including Special Status Species
Corrin MacLuckie	Kleinfelder, Inc.	Resource Specialist/Soils; Water Resources, Including Surface and Groundwater Quality, Hydrologic (Stormwater) Condition, Floodplains, and Waters of the United States; and Vegetation, Including Grassland and Shrubland Communities, Riparian and Wetland Communities, Invasive and Nonnative Plant Species, Pest Control, and Special Status Species
Chad Incorvia	Kleinfelder, Inc.	Resource Specialist/Livestock Grazing
Elyssa Figari	Kleinfelder, Inc.	Resource Specialist / Cultural Resources
Jacob Weber	Kleinfelder, Inc.	GIS Analyst

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