DECISION RECORD
For
Anadarko E&P Onshore LLC's Kinney Divide Unit Epsilon 2 POD
WY-070-14-264
Bureau of Land Management, Buffalo Field Office

This Decision Record approves sixteen (16) applications for permit to drill (APDs), a water management plan (WMP), and associated infrastructure with the Kinney Divide Unit Epsilon 2 plan of development (POD) to drill for coalbed natural gas (CBNG). The development is subject to all lease stipulations and conditions of approval (COAs). All APDs listed in Anadarko E&P Onshore LLC's Kinney Divide Unit Epsilon 2 CBNG POD were onsited in 2014. The decision is based upon the analysis from Environmental Assessment WY-070-14-264, the Buffalo RMP and its amendments. The APDs, water management plan (WMP), and associated infrastructure were evaluated under Alternative B.

COMPLIANCE.
This decision complies with:

- Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1701).
- Mineral Leasing Act of 1920 (30 USC 181) and as prescribed in 43 CFR Part 3160 to include On Shore Order No. 1.
- National Environmental Policy Act of 1969 (NEPA) (42 USC 4321).
- Endangered Species Act (ESA) of 1973 (16 USC 1531).
- National Historic Preservation Act of 1966 (NHPA) (16 USC 470).
- Migratory Bird Treaty Act of 1918. (16 USC 703).
- 1985 Buffalo Resource Management Plan (updated 2001).
- Powder River Basin Final Environmental Impact Statement (FEIS) and RMP Amendment (2003).
- Fortification Creek Environmental Assessment and RMP Amendment (2011).

DECISION FEATURES.
APDs:

The BFO approves these 16 APDs:

	Well Name	QTR	Sec	TWP	RNG	Lease
1	KDU Fed 11-19-5176	NWNW	19	51N	76W	WYW137646
2	KDU Fed 12-19-5176	SWNW	19	51N	76W	WYW137646
3	KDU Fed 22-19-5176	SENW	19	51N	76W	WYW137646
4	KDU Fed 41-22-5177	NENE	22	51N	77W	WYW146312
5	KDU Fed 11-23-5177	NWNW	23	51N	77W	WYW146311
6	KDU Fed 21-23-5177	NENW	23	51N	77W	WYW138448
7	KDU Fed 22-23-5177	SENW	23	51N	77W	WYW138448
8	KDU Fed 31-23-5177	NWNE	23	51N	77W	WYW138448
9	KDU Fed 41-23-5177	NENE	23	51N	77W	WYW138448
10	KDU Fed 43-23-5177	NESE	23	51N	77W	WYW138448
11	KDU Fed 11-24-5177	NWSW	24	51N	77W	WYW138448
12	KDU Fed 12-24-5177	SWNW	24	51N	77W	WYW138448
13	KDU Fed 13-24-5177	NWSW	24	51N	77W	WYW138448

	Well Name	QTR	Sec	TWP	RNG	Lease
14	KDU Fed 32-24-5177	SWNE	24	51N	77W	WYW146311
15	KDU Fed 41-24-5177	NENE	24	51N	77W	WYW146311
16	KDU Fed 51-24-5177	NENE	24	51N	77W	WYW146311

Water Management:
The water treatment facilities and associated existing infrastructure in the table below were inspected and approved for use in association with the water management strategy for the POD. The water would be piped to the existing Camp John and Augusta water pump station located in the NWNE Quarter/Quarter (Qtr/Qtr) of Section 22, Township (T) 51 North (N), Range (R) 76 West (W) for transport to the Barber Creek treatment facility or directly discharged at an existing outfall in Turner Draw.

Facility Name	NEPA Documents	WYPDES	Lease	Outfall	QTR	Sec	TWN	RNG
River Road CBM Facility	KDU Gamma POD; WY-070-EA10-271	WY0056081	WYW149359	046	SWSW	4	50	77
River Road CBM Facility	KDU Epsilon POD; WY-070-EA12-148	WY0056081	WYW146315	053	NENW	28	51	77

The FCPA-RMPA goal is to maintain a viable elk herd across the FCPA utilizing their seasonal ranges during the appropriate seasons. The current status of the elk performance standards are as follows:

1. **Herd Unit population** – Post hunt population estimate was 256 in 2011 (POP-II estimate, WGFD 2011 Job Completion Report (JCR)) and 511 in 2012. The WGFD changed population models in 2012; while the population likely increased in 2012 it is unlikely that the population doubled.
2. **Calf production -** The estimated post-season 9-year average cow:calf ratio is100:50.26 (2004-2012 WGFD 2012 JCR, subadults/100 females). The ratio indicates an increase of 4.76 calves per 100 cows.
3. **Winter calf survival** – The estimated adult:calf ratio for spring 2014 is 100:51 (Peckham 2015). A spring helicopter survey was initiated in 2012 to produce a more reliable estimate of the winter calf survival, than basing the estimate on the end of year ratio presented in the RMPA. The 2012 calf:antlerless elk ratio was 38 calves per 100 antlerless animals. The ratio is presented as 'antlerless' versus 'cows' as it was difficult to confidently classify elk at this time of year.
4. **Next-summer calf survival (calf to yearling)** – The estimated 2013 cow:yearling ratio is100:40 (Peckham 2014). The ratio indicates an increase of 7 yearlings per 100 cows from the RMPA average. The new model used by WGFD does not calculate next-summer calf survival, therefore 2013 is the most current figure available.
5. **Range Fidelity (yearlong, calving, crucial winter)** – During the biological years, May 15 – May 14, 2008 through 2011, 78% of the herd unit elk locations were within the FCPA yearlong range (112,924 of 145,442 locations). During the 2008 through 2012 calving seasons 71% of the herd unit elk locations were within the FCPA calving range (12,324 of 17,344 locations. During the 2008 through 2011 winter seasons, December 1 – April 30, 40% of the herd unit elk locations were within the FCPA crucial winter range (24,009 of 60,308 locations).
6. **Security habitat** – There are 45,354 acres of elk security habitat within the yearlong range of which 29.759 acres are within calving areas and 20,435 acres are within crucial winter range. A loss of approximately 922 acres or 16.5 percent of elk security habitat within the southeast development phase of the FCPA is anticipated from the 99 previously analyzed federal APDs included in the CJU SMA Phase 1 Year1 and CJU SMA Phase 1 Year2 PODs. Additional loss as a result of nonfederal APDs increased total elk security habitat loss to 1,101 acres (19.7%). KDUE2 POD is the first

project analyzed within the southwest development phase.

7. **Habitat effectiveness** – As of January 1, 2015, over 280,000 relocation data have been recorded over the 81 months (March 2008 through December 2014) of monitoring with the GPS collars. Fifty-two (115) of the GPS collars deployed have recorded 7,335 observations (2.6% of all observations) within the KDUE2 project boundary. This project area has the highest density of elk relocations observed from CBNG projects previously analyzed within the FCPA. The data does not show a strong trend for elk to select habitat within the project area for a particular season (i.e. calving or winter). The elk appear to utilize the available habitat within the POD year-round.

THE FINDING OF NO SIGNIFICANT IMPACT.

Analysis of Alternative B of WY-070-EA14-264, and the FONSI found the POD will have no significant impacts on the human environment, beyond those described in the PRB FEIS, thus an EIS is not required.

DECISION RATIONALE.

The decision authorizing the 16 APDs, WMP, and associated POD infrastructure as described in Alternative B, and analyzed in WY-070-EA14-264, is also based on the following:

1. Mitigation measures and COAs analyzed in the EA analysis, in environmental impact statements, or environmental analysis to which are incorporated by reference, will reduce environmental impacts while meeting the BLM's need.
2. The approved project conditioned by its design features and COAs, will not result in any undue or unnecessary environmental degradation. The PRB FEIS analyzed and predicted that the PRB oil and gas development would have significant impacts to the region's Greater Sage-Grouse (GSG) population. The impact of this development cumulatively contributes to the potential for local GSG extirpation; yet its effect is acceptable because it is outside priority habitats and is within the parameters of the PRB FEIS/ROD and current BLM and Wyoming GSG conservation strategies.
3. There are no conflicts anticipated or demonstrated with current uses in the area. This decision approving this APD complies with the Energy Policy Act of 2005, Section 390, 43 CFR 1610.5, 40 CFR 1508.4, and 43 CFR 46.215.
4. To reduce the likelihood of a "take" under the Migratory Bird Treaty Act, BLM sensitive species nesting habitat removal will occur outside of the breeding season or be cleared by survey.
5. Approval of this project conforms to the terms and the conditions of the 1985 Buffalo RMP (BLM 1985) and subsequent update (BLM 2001) and amendments (BLM 2003, 2011). This project complies with the breadth and constraints of the Energy Policy Act of 2005, and subsequent policy.
6. The selected alternative will help meet the nation's energy need, revenues, and stimulate local economies by maintaining workforces.
7. The operator, in their APD, shall:
   - Comply with all applicable federal, state, and local laws and regulations.
   - Offer water well agreements to the owners of record for permitted water wells within 0.5 mile of a federal producing well in the APD (PRB FEIS ROD, p. 7).
8. The project is clearly lacking in wilderness characteristics because it is amidst mineral development.
9. This decision does not foreclose the lessee or operator to propose a new or supplementary plan for developing the federal oil and gas leases in this project area, including submission of additional APDs to drain minerals in accord with lease rights and law. This decision does not foreclose the lessee or operator to propose using external pumping units via a sundry application process.
10. Anadarko certified it has a surface access agreement with the landowners or it posted a bond.
11. This approval is subject to adherence with all of the operating plans, design features, and mitigation measures contained in the surface use plan of operations and drilling plan information in the individual APD.
12. The environmental consequences are predicted to remain within the performance standards of the

Fortification Creek Environmental Assessment and RMP Amendment (2011).

- There are currently four approved federal projects (Anadarko's Camp John SMA Phase 1 Year 2, and Camp John SMA Phase 1 Year 1, Yates Petroleum's Queen B, and Yates' Elsie) including 97 APDs. Anticipated security habitat loss cumulatively for all four projects is within the performance standards.
- CBNG development within the Fortification Creek Planning Area, Southeast Development area has been limited to ten (10) unit obligation wells (Federal and Non-federal locations). Anadarko committed to keep the geographic area containing the wells to be drilled as small as practical and adjacent to existing development. The wells drilled in 2013 were all located within the Camp John SMA Phase 1 year 1 POD. Both Anadarko and Yates verbally stated that they do not have any activities planned within the FCPA for 2015.
- While the RMPA/EA anticipated an orderly progression of development through the geographic phases, it allowed for exceptions (i.e Marathon's Rough Horse POD, Proposed RMPA/EA pg 4-142) provided compliance with all performance standards.
- While all 16 new wells of the KDUE2 POD are outside the FCPA there will be approximately 0.45 miles road and buried utility corridor within the South West Development Area.
- Given the current level of elk use within the Kinney Divide Unit Epsilon 2 POD and within the areas of the other authorized PODs, habitat effectiveness and range fidelity are not anticipated to fall below the performance standards.

ADMINISTRATIVE REVIEW AND APPEAL.

Under BLM regulations, this decision is subject to administrative review in accordance with 43 CFR 3165. Any request for administrative review of this decision must include information required under 43 CFR 3165.3(b) (State Director Review), including all supporting documentation. Such a request must be filed in writing with the State Director, Bureau of Land Management, P.O. Box 1828, Cheyenne, Wyoming 82003, no later than 20 business days after this Decision Record is received or considered to have been received.

Any party who is adversely affected by the State Director's decision may appeal that decision to the Interior Board of Land Appeals, as provided in 43 CFR 3165.4.

Field Manager: /s/ Duane W. Spencer Date: 2/27/15

FINDING OF NO SIGNIFICANT IMPACT
For
Anadarko E&P Onshore LLC's Kinney Divide Unit Epsilon 2 POD
WY-070-EA14-264
Bureau of Land Management,
Buffalo Field Office

FINDING OF NO SIGNIFICANT IMPACT:
On the basis of the information contained in the environmental assessment (EA), and all other information available to me, it is my determination that:

1) The decision to approve 16 applications to drill (APDs), a water management plan (WMP), and associated plan of development (POD) infrastructure previously onsited in the Anadarko E&P Onshore LLC (Anadarko) Kinney Divide Unit Epsilon 2 coalbed natural gas (CBNG) POD will not have significant environmental impacts beyond those already addressed in the Powder River Basin (PRB) Final Environmental Impact Statement (FEIS) (2003), to which the EA is tiered.
2) The approved project conditioned by its design features and COAs, will not result in any undue or unnecessary environmental degradation. The PRB FEIS analyzed and predicted that the PRB oil and gas development would have significant impacts to the region's GSG population. The impact of this development cumulatively contributes to the potential for local GSG extirpation; yet its effect is acceptable because it is outside priority habitats and is within the parameters of the PRB FEIS/ROD and current BLM and Wyoming GSG conservation strategies.
3) The decision to approve 16 APDs is within the parameters of the Fortification Creek RMPA (2011) performance standards. The decision will have minor adverse impacts to the Fortification Creek elk and their habitat. The adverse impacts will contribute to the cumulative impacts from this development and other developments within the elk range.

    - There are currently four approved federal projects (Anadarko's Camp John SMA Phase 1 Year1 Camp John SMA Phase 1 Year2 POD, and Yates Petroleum's Queen B, and Elsie PODs) including 97 AAPDs. Anticipated security habitat loss cumulatively for all four projects is within the performance standards.
    - CBNG Development within the Fortification Creek Planning Area, Southeast Development area has been initiated. It is not anticipated that drilling and construction will occur within the four authorized projects concurrently. Anadarko provided a written annual development plan limiting their drilling activities in 2013 to ten (10) unit obligation wells including Federal and Non-federal locations. Anadarko committed to keep the geographic area containing the wells to be drilled as small as practical and adjacent to existing development. The wells drilled in 2013 are all located within the Camp John SMA Phase 1 year 1 POD. Anadarko and Yates Petroleum have verbally stated that they do not have any activities planned within the FCPA for 2015.
    - While the RMPA/EA anticipated an orderly progression of development through the geographic phases, it allowed for exceptions (i.e Marathon's Rough Horse POD, Proposed RMPA/EA pg 4-142) provided compliance with all performance standards.
    - Given the current level of elk use within the Kinney Divide Unit Epsilon 2 POD and within the areas of the other authorized PODs, habitat effectiveness and range fidelity are not anticipated to fall below the performance standards.
    - While all 16 new wells of the KDUE2 POD are outside the FCPA there will be approximately 0.45 miles road and buried utility corridor within the South West Development Area.
4) The decision to authorize 16 APDs is in conformance with the Buffalo Field Office (BFO) Resource

Management Plan (RMP) (1985, 2001) and amendments (2003, 2011), and other legislative or regulatory processes.

5) The decision to authorize the 16 APDs does not constitute a major federal action having a significant effect on the human environment. Therefore, an environmental impact statement is not necessary and will not be prepared.

This finding is based on my consideration of the Council on Environmental Quality's (CEQ) criteria for significance (40 CFR 1508.27), both with regard to the context and to the intensity of the impacts described in the EA, WY-070-14-264, which is incorporated here by reference.

CONTEXT:
The Fortification elk are a small isolated herd living in a prairie environment. Such prairie herds were common prior to European expansion on the western plains. Today, elk herds occupying prairie habitats are unusual though not unique and are therefore of local interest and importance. The public, conservation groups, and the State of Wyoming have all expressed their interest in maintaining a viable elk herd within the Fortification Creek Planning Area (FCPA). The Fortification Creek RMPA included elements such as phasing development and performance standards such as maintaining the elk herd above 80% of the Wyoming Game and Fish Department (WGFD) population objective. The impacts described by the EA comply with the performance standards.

Performance Standard Compliance
Herd Unit population – Post hunt population estimate was 256 in 2011 (POP-II estimate, WGFD 2011 Job Completion Report (JCR)) and 511 in 2012. The WGFD changed population models in 2012; while the population likely increased in 2012 it is unlikely that the population doubled.

Calf production - The estimated post-season 9-year average cow:calf ratio is100:50.26 (2004-2012 WGFD 2012 JCR, subadults/100 females). The ratio indicates an increase of 4.76 calves per 100 cows.

Winter calf survival – The estimated adult:calf ratio for spring 2014 is 100:51 (Peckham 2015). A spring helicopter survey was initiated in 2012 to produce a more reliable estimate of the winter calf survival, than basing the estimate on the end of year ratio presented in the RMPA. The 2012 calf:antlerless elk ratio was 38 calves per 100 antlerless animals. The ratio is presented as 'antlerless' versus 'cows' as it was difficult to confidently classify elk at this time of year.

Next-summer calf survival (calf to yearling) – The estimated 2013 cow:yearling ratio is100:40 (Peckham 2014). The ratio indicates an increase of 7 yearlings per 100 cows from the RMPA average. The new model used by WGFD does not calculate next-summer calf survival, therefore 2013 is the most current figure available.

Range Fidelity (yearlong, calving, crucial winter) – During the biological years, May 15 – May 14, 2008 through 2011, 78% of the herd unit elk locations were within the FCPA yearlong range (112,924 of 145,442 locations). During the 2008 through 2012 calving seasons 71% of the herd unit elk locations were within the FCPA calving range (12,324 of 17,344 locations. During the 2008 through 2011 winter seasons, December 1 – April 30, 40% of the herd unit elk locations were within the FCPA crucial winter range (24,009 of 60,308 locations).

Security habitat – There are 45,354 acres of elk security habitat within the yearlong range of which 29.759 acres are within calving areas and 20,435 acres are within crucial winter range A loss of approximately 922 acres or 16.5 percent of elk security habitat within the southeast development phase of the FCPA is anticipated from the 99 previously analyzed federal APDs included in the CJU SMA Phase 1 Year1 and CJU SMA Phase 1 Year2 PODs. Additional loss as a result of nonfederal APDs increased

total elk security habitat loss to 1,101 acres (19.7%). KDUE2 POD is the first project analyzed within the southwest development phase.

Habitat effectiveness – As of January 1, 2015, over 280,000 relocation data have been recorded over the 81 months (March 2008 through December 2014) of monitoring with the GPS collars. Fifty-two (115) of the GPS collars deployed have recorded 7,335 observations (2.6% of all observations) within the KDUE2 project boundary. This project area has the highest density of elk relocations observed from CBNG projects previously analyzed within the FCPA. The data does not show a strong trend for elk to select habitat within the project area for a particular season (i.e. calving or winter). The elk appear to utilize the available habitat within the POD year-round.

Oil and gas development is a long-standing and common land use within the Powder River Basin including the FCPA. The Fortification Creek RMP amendment (USDI BLM 2011a) reported 480 wells present within the FCPA (397 CBNG wells, 239 conventional gas wells, and five oil wells). The PRB FEIS reasonably foreseeable development predicted and analyzed the development of 51,000 CBNG wells and 3,200 oil wells (PRB FEIS ROD pg. 2). The additional CBNG development described in Alternative B is insignificant within the national, regional, and local context.

INTENSITY:

The implementation of Alternative B will result in beneficial effects in the forms of energy and revenue production however; there will also be adverse effects to the environment. Anadarko proposed design features to prevent significant adverse environmental effects. The BLM also added site specific and programmatic mitigation measures to further reduce adverse environmental effects of this development.

The preferred alternative does not pose a significant risk to public health and safety. The geographic area of the POD does not contain unique characteristics identified within the 1985 RMP, 2003 PRB FEIS, or other legislative or regulatory processes, including DIO Order 3310 and supporting manuals. Large tracts of BLM lands within the FCPA were identified and inventoried. The BFO did not find any lands with wilderness characteristics outside the WSA.

Relevant scientific literature and professional expertise were used in preparing the EA. The scientific community is reasonably consistent with their conclusions on environmental effects relative to oil and gas development. Research findings on the nature of the environmental effects are not highly controversial, highly uncertain, or involve unique or unknown risks.

CBNG development of the nature proposed with this POD and similar PODs was predicted and analyzed in the PRB FEIS and the FCPA RMPA; the selected alternative does not establish a precedent for future actions with significant effects.

There are no cultural or historical resources present that will be adversely affected by the selected alternative (EA sec 4.2.6). This federal action is clearly lacking wilderness characteristics. No species listed under the Endangered Species Act or their designated critical habitat will be adversely affected (EA, sec. 4). The selected alternative will not have any anticipated effects that would threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

Field Manager: /s/ Duane W. Spencer Date: 2/27/15

ENVIRONMENTAL ASSESSMENT
for
Anadarko E&P Onshore LLC
KINNEY DIVIDE UNIT EPSILON 2 POD
WY-070-14-264
BUREAU OF LAND MANAGEMENT
BUFFALO FIELD OFFICE

ACRONYMS AND ABBREVIATIONS

µg/l	Micrograms per Liter
µS/cm[1]	MicroSiemens per Centimeter
Anadarko	Anadarko E&P Onshore LLC
AO	Authorized Officer
APD	Application for a Permit to Drill
AP	Approved Permit (Wyoming Oil and Gas Conservation Commission)
BCC	Bird of Conservation Concern
BFO	Buffalo Field Office
BGEPA	Bald and Golden Eagle Protection Act
bgs	Below Ground Surface
BHEC	Big Horn Environmental Consultants
BKS	BKS Environmental Consultants, Inc.
BLM	Bureau of Land Management
CBM	Coalbed Natural Methane
CBNG	Coalbed Natural Gas
CCIX	Continuous Countercurrent Ion Exchange
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
COA	Conditions of Approval
CSU	Conditional Surface Use
EA	Environmental Assessment
EC	Electrical Conductivity
ESA	Endangered Species Act (1973)
ESH	Elk Security Habitat
FCPA	Fortification Creek Planning Area
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act (1976)
gpm	Gallons per Minute
ID team	Interdisciplinary team
IPMP	Integrated Weed and Pest Management Plan
Lance	Lance Oil and Gas Company Inc.
LOS	Line of Sight
LRP	Limited Reclamation Potential
MBTA	Migratory Bird Treaty Act
MCF	Million Cubic Feet
mg/l	Milligrams Per Liter
MLA	Mineral Leasing Act
MLRA	Major Land Resource Area
MMBtu	Million Metric British Thermal Units

MMRP	Monitoring, Mitigation, and Reporting Plan
MOU	Memorandum of Understanding
MSUP	Multi-Point Surface Use and Operations Plan
N	North
NEPA	National Environmental Policy Act
NLCD	National Land Cover Database
NP	Normal Precipitation
NRCS	Natural Resources Conservation Service
NSO	No Surface Occupancy
NSS	Native Species Status
p.	Page
pp.	Pages
PLS	Pure Live Seed
POD	Plan of Development
PRB	Powder River Basin
PRS	Poor Reclamation Suitability
PSS	Poor Slope Stability
PV	Present Value
Qtr/Qtr	Quarter/Quarter
R	Range
RMP	Resource Management Plan
RMPA	Resource Management Plan Amendment
ROD	Record of Decision
SMA	Special Management Area
SAR	Sodium Adsorption Ratio
SGCN	Species of Greatest Conservation Need
SEH	Severe Erosion Hazard
SSURGO	Soil Survey Geographic Database
SWDP	Southwest Development Phase
T	Township
TDS	Total Dissolved Solids
TLS	Timing Limitation Stipulation
U.S.	United States
UIC	Underground Injection Control
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
W	West
WBD	Watershed Boundary Dataset
WDEQ	Wyoming Department of Environmental Quality
WNv	West Nile Virus
WGFD	Wyoming Game and Fish Department
WMP	Water Management Plan
WOGCC	Wyoming Oil and Gas Conservation Commission
WSA	Wilderness Study Area
WSEO	Wyoming State Engineer’s Office
WYNDD	Wyoming Natural Diversity Database
WYPDES	Wyoming Pollutant Discharge Elimination System

CONTENTS

1. INTRODUCTION 1
1.1. Background 1
1.2. Purpose and Need for the Proposed Action 2
1.3. Decision to be Made 2
1.4. Conformance with Land Use Plan and Other Applicable Laws, Regulations, and Policies 2
1.5. Public Involvement 2
1.5.1. Scoping and Issues 2
1.5.2. Public Review 3
2. ALTERNATIVES INCLUDING THE PROPOSED ACTION 3
2.1. Alternative A - No Action 3
2.2. Alternative B – Operator Proposed Action 4
2.3. Summary of Alternatives 6
2.4. Alternatives Considered but Not Analyzed in Detail 6
2.5. Conformance 6
3. AFFECTED ENVIRONMENT 6
3.1. Project Area Description 6
3.2. Air Quality 8
3.3. Transportation 8
3.4. Soils and Vegetation 9
3.4.1 Soils Susceptible to Erosion 10
3.4.2 Limited Reclamation Potential 11
3.4.3 Slope in Excess of 25 Percent 11
3.4.3.1. Reclamation Suitability (Source Material) 12
3.4.4. Vegetation and Ecological Sites 12
3.5. Water Resources 14
3.5.1. Groundwater 14
3.5.2. Surface Water 15
3.6. Wetlands/Riparian 16
3.7. Noxious Weeds and Invasive Species 16
3.8. Wildlife 17
3.8.1. Habitat Types 17
3.8.2. Big Game 18
3.8.2.1. General 18
3.8.2.2. Elk 19
3.9. Migratory Birds 24
3.10. Raptors 25
3.11. Upland Game Birds (Plains Sharp-tailed Grouse) 25
3.12. Threatened, Endangered, Candidate and Special Status (Sensitive) Species (SSS) 25
3.12.1. Threatened and Endangered Species 25
3.12.1.2. Northern long-eared bat 25
3.12.2. Greater Sage-Grouse(GSG) 26
3.13. BLM Sensitive Species 27
3.13.1.1. Bald Eagle 27
3.13.1.2. Ferruginous Hawk 27
3.13.1.3. Fringed Myotis 27
3.13.1.4. Long-eared Myotis 27
3.14. Aquatics 28
3.15. West Nile Virus 28
3.16. Cultural Resources 30
3.17. Recreation 30

4. ENVIRONMENTAL EFFECTS 30
4.1. Project Area Land Uses 31
4.1.1. Direct and Indirect Effects 31
4.1.2. Cumulative Effects 32
4.1.3. Mitigation Measures 32
4.1.4. Residual Effects 32
4.2. Air Quality 32
4.3. Transportation 32
4.3.1. Direct and Indirect Effects 32
4.3.2. Mitigation 33
4.4. Soils 33
4.4.1. Direct and Indirect Effects 33
4.4.2. Soils Susceptible to Severe Erosion 36
4.4.3. Limited Reclamation Potential (LRP) 36
4.4.3.1. Slope in Excess of 25 Percent 37
4.4.3.2. Cumulative Effects 37
4.4.3.3. Mitigation Measures 38
4.4.3.4. Residual Effects 40
4.5. Vegetation and Ecological Sites 40
4.5.1. Direct and Indirect Effects 40
4.5.2. Cumulative Effects 41
4.5.3. Mitigation Measures 41
4.5.4. Residual Effects 42
4.6. Water Resources 42
4.6.1. Groundwater 44
4.6.1.1. Direct and Indirect Effects 44
4.6.1.2. Cumulative Effects 44
4.6.1.3. Mitigation Measures 45
4.6.1.4. Residual Effects 45
4.6.2. Surface Water 45
4.6.2.1. Direct and Indirect Effects 45
4.6.2.2. Cumulative Effects 45
4.6.2.3. Mitigation Measures 47
4.6.2.4. Residual Effects 47
4.6.3. Wetlands/Riparian 47
4.6.3.1. Mitigation 47
Channel crossings by road will be constructed perpendicular to flow. Culverts will be installed at appropriate locations for streams and channels crossed by roads as specified in the BLM Manual 9112-Bridges and Major Culverts and Manual 9113-Roads. Streams will be crossed perpendicular to flow, where possible, and all stream crossing structures will be designed to carry the 25 year discharge event or other capacities as directed by the BLM. Channel crossings by pipelines will be constructed so that the pipe is buried at least four feet below the channel bottom. 47
4.6.4. Noxious Weeds and Invasive Species 47
4.7. Wildlife 47
4.7.1. Habitat Types 47
4.7.2. Big Game 48
4.7.2.1. Elk 48
4.7.3. Migratory Birds 50
4.7.3.1. Direct and Indirect Effects 50
4.7.3.2. Cumulative Effects 50
4.7.3.3. Mitigation Measures 50

4.7.3.4. Residual Effects 51
4.7.4. Raptors 51
4.7.4.1. Direct and Indirect Effects 51
4.7.4.2. Cumulative Effects 51
4.7.4.3. Mitigation Measures 51
4.7.4.4. Residual Impacts 52
4.7.5. Upland Game Birds (Plains Sharp-tailed Grouse) 52
4.7.5.1. Direct and Indirect Effects 52
4.7.5.2. Cumulative Effects 52
4.7.5.3. Mitigation Measures 53
4.7.5.4. Residual Effects 53
4.7.6. Wildlife Threatened, Endangered, Proposed and Candidate Species 53
4.7.6.1. Ute Ladies'-Tresses Orchid 53
4.7.6.2. Northern Long-eared Bat 53
4.7.7. Candidate Species, Greater Sage-Grouse 53
4.7.7.1. Direct and Indirect Effects 53
4.7.7.2. Cumulative Effects 53
4.7.7.3. Mitigation Measures 54
4.7.7.4. Residual Effects 54
4.7.8. Sensitive Species 55
4.7.8.1. Bald Eagle 55
4.7.8.2. Ferruginous Hawk 55
4.7.8.3. Fringed Myotis and Long-eared Myotis 56
4.7.8.4. Aquatics Species 56
4.7.8.5. West Nile Virus 56
4.7.9. Cultural Resources 57
4.7.9.1. Direct and Indirect Effects 57
4.7.9.2. Cumulative Effects 57
4.7.9.3. Mitigation Measures 58
4.7.9.4. Residual Effects 58
4.7.10. Recreation 58
4.7.10.1. Direct and Indirect Effects 58
4.7.10.2. Cumulative Effects 58
4.7.10.3. Mitigation Measures 58
4.7.10.4. Residual Effects 58
5. LIST OF PREPARERS (BFO unless otherwise noted) 59
6. REFERENCES AND AUTHORITIES 59

NY**LIST OF TABLES**

Table 2.1 Complete APDs – Adjacent or Overlapping CBNG PODs
Table 2.2 Complete APDs - Alternative B Well Descriptions
Table 2.3 Existing water treatment facility
Table 2.4 Disturbance Summary for KDUE2
Table 3.1 This Project Incorporates by Reference These Project Level NEPA Documents
Table 3.2 Dominant Soils Affected by the Proposed Action
Table 3.3 Erosion Potential within the KDUE2 Project Area
Table 3.4 Percent Slope within the KDUE2 Project Area
Table 3.5 Reclamation Potential within the KDUE2 Project Area
Table 3.6 Ecological Sites and Soils Map Units within the KDUE2 Project Area
Table 3.7 Acres of Elk Ranges/Habitats within the KDUE2POD
Table 3.8 Migratory Bird Species Occurring in Shrub-Steppe Habitat, NE Wyoming (Nicholoff 2003)
Table 3.9 Fish Occurring in the Upper Powder River Sub-Watershed
Table 3.10 Historical West Nile Virus Information
Table 3.11 Cultural Resource Sites In or Near the KDUE2POD
Table 4.1 Location of Discussion of the No Action Alternative in the PRB FEIS
Table 4.2 Wells, Roads and Infrastructure with Site Specific Reclamation Plans
Table 4.3 Comparison of Regulated Water Quality Parameters to Predicted Water Quality
Table 445 Actual vs Predicted Water Production in the Upper Powder River Sub-Watershed
Table 4.5 Well Density within the 12.4 Mile Impact Area

LIST OF FIGURES

Figure 3.1 Cedar Draw Water Well Monitoring Wells Water Levels
Figure 3.2 Photo Representative of the Habitat Types within the KDUE2 Project Area
Figure 3.3 Affected Environment - Fortification Elk Herd Ranges
Figure 3.4 Kinney Divide Unit Epsilon 2 Project Area
Figure 3.5 Elk Security Habitat and Effective Elk Habitat
Figure 3.6 Average Peak of Greater Sage-Grouse Males at WGFD count Leks by Year in the PRB
Figure 4.1 Elk Ranges, Security Habitat, Proposed and Existing Wells and Roads

ENVIRONMENTAL ASSESSMENT (EA)
for
Anadarko E&P Onshore LLC
KINNEY DIVIDE UNIT EPSILON 2 POD
WY-070-EA14-264
BUREAU OF LAND MANAGEMENT
BUFFALO FIELD OFFICE

1. INTRODUCTION

This Environmental Assessment (EA) analyzes the environmental impacts of 16 applications for permit to drill (APDs) in the Kinney Divide Unit Epsilon 2 (KDUE2) coalbed natural gas (CBNG) Plan of Development (POD). This site-specific analysis tiers into and incorporates by reference the information and analysis contained in the Powder River Basin Oil and Gas Project Final Environmental Impact Statement and Resource Management Plan Amendment (PRB FEIS), WY-070-02-065 (issued January 2003), Record of Decision (ROD) and Resource Management Plan (RMP) Amendments for the Powder River Basin Oil and Gas Project (PRB ROD) (approved April 30, 2003), and the Fortification Creek Planning Area Resource Management Plan Amendment/Environmental Assessment (FCPA RMPA/EA) WY-070-08-135 (approved August 5, 2011), pursuant to 40 Code of Federal Regulations (CFR) 1508.28 and 1502.21 (U.S. Department of the Interior, Bureau of Land Management [USDI BLM] 2003a, 2003b). These documents are available for review at the BLM Buffalo Field Office (BFO). This project EA addresses site-specific resources and impacts that were not covered within the PRB FEIS or FCPA RMPA.

1.1. Background

The current land use plan was prepared in 1985 and updated in 2001. In 2003, BLM prepared a RMPA/Environmental Impact Statement (EIS) for oil and gas development within the Powder River Basin (PRB), which includes the FCPA (BLM 2003a). The PRB RMPA/EIS did not adequately address protection of the isolated elk herd found within the FCPA.

New information has been collected regarding the Fortification elk herd. Past management decisions specific to the FCPA, such as the overhead power prohibition on BLM surface, did not consider CBNG development. BLM determined that in order to address these issues an RMPA specific to the FCPA was necessary. The formal scoping period began on August 20, 2007; with the publication of the Notice of Intent (NOI) to prepare the RMPA/EA in the Federal Register. Critical issues that the RMPA addressed were wildlife, cultural, paleontological, visual resources, and how to best manage fluid mineral development in a region with erosive soils and steep slopes. The FCPA RMPA EA provides the analysis upon which to base project-specific decisions for CBNG development within the FCPA.

The Kinney Divide Unit Epsilon POD was originally submitted on March 28, 2011 by Lance Oil and Gas Company, Incorporated (Lance) a wholly owned subsidiary of Anadarko E&P Onshore LLC (Anadarko) On April 1, 2013 a formal change of operator was submitted replacing Lance Oil and Gas Company Inc. with the parent company, Anadarko.

The POD contained 41 Federal APD's and 31 Notices of Staking (NOS) to develop and produce natural gas resources within coal bearing formations of the Powder River Basin (PRB). A series of discussions occurred between BLM and Anadarko based on the initial project and onsite visits. As a result of these discussions, the following adjustments were made to the original Kinney Divide Unit Epsilon POD:

- 23 NOSs did not have APDs submitted due to lack of access created by steep slopes with highly erosive soils and limited reclamation potential.

- 16 APDs, 1 NOS and associated infrastructure were removed from the proposal to be processed in a future proposal due to their proximity to the Fortification Creek Planning Area (FCPA); within 0.5 miles. The wells and their infrastructure would impact elk security habitat and other resources within the FCPA which has defined performance standards. Kinney Divide Unit Epsilon 2 POD is these 16APDs. The associated NOS was withdrawn by the operator to avoid impacts to steep slopes and fragile soils.
- The remaining 25 APDs and 7 NOSs were processed as Lance's Kinney Divide Unit Epsilon POD, WY-070-EA12-148, authorized on 8/04/2012.

In May 2014, BLM and Anadarko agreed to complete processing the remaining APDs as the Kinney Divide Unit Epsilon 2 POD. Onsites were again conducted June 11-12, 2014. Anadarko submitted a revised well list including 16 APDs (the 44-23-5177 was withdrawn) surface use plan, drilling prognosis, well plats, well pad designs, and project maps on October 9, 2014. BLM sent a post onsite deficiency letter to Anadarko on October 22, 2014. Anadarko responded to the post onsite deficiencies on December 17, 2014. The project proposal and APDs were considered complete when BLM received the operator's final response to the post onsite deficiencies on February 5, 2015. Proposed conditions of approval (COAs) were shared with the operator with the onsite notes included in the deficiency letter. Proposed conditions of approval (COAs) were shared with the operator on February 11, 2015.

1.2. Purpose and Need for the Proposed Action

The purpose of the proposed action is to explore, develop, and produce coalbed natural gas conducted under the rights granted by a Federal oil and gas lease, as required in 43 CFR 3160, all Onshore Orders, and The Mineral Leasing Act, as amended and supplemented (30 U.S.C. 181 et seq.).

The need for the action is the requirement to obtain approval for the development of an Oil and Gas Lease through an APD on public lands managed by the Bureau of Land Management under Onshore Order No. 1, pursuant to the authority of the Mineral Leasing Act, as amended and supplemented, (30 U.S.C. 181 et seq.) and prescribed in 43 CFR Part 3160.

1.3. Decision to be Made

The BLM will decide whether or not to approve the proposed development of CBNG resources on the federal leasehold, and if so, under what terms and conditions agreeing with the Bureau's multiple use mandate, environmental protection, and RMP.

1.4. Conformance with Land Use Plan and Other Applicable Laws, Regulations, and Policies

The proposed action conforms to the terms and the conditions of the 1985 Buffalo RMP, the 2003 PRB RMPA/FEIS (including the PRB ROD), and the 2011 Fortification Creek Planning Area RMPA/EA (USDI BLM 1985, 2003a, 2003b, and 2011). The proposed action is in compliance with all Federal laws, regulations, and policies. This includes, but is not limited to, the Federal Land Policy and Management Act (FLPMA) (1976), the Mineral Leasing Act of (1920), the National Historic Preservation Act (1966), the Endangered Species Act (ESA) (1973), the Migratory Bird Treaty Act (MBTA) (1918), the Clean Water Act (1972), the Clean Air Act (1970), and the National Environmental Policy Act (1969).

1.5. Public Involvement

1.5.1. Scoping and Issues

External scoping was not conducted for this EA. Extensive external scoping was conducted for the PRB FEIS and is discussed beginning on p. 15 of the ROD and beginning on p. 2-1 of the PRB FEIS. External scoping also was performed for the Fortification Creek Planning Area RMPA/EA (BLM 2011a), as described starting on p. 1-6 to 1-7.

The BLM interdisciplinary team (ID team) conducted internal scoping by reviewing the proposed development and project location to identify potentially affected resources and land uses. Appendix B identifies those resources and land uses present and affected by the proposed action; those resources and land uses that are either not present, not affected, or were adequately covered by the PRB FEIS will not be discussed in this EA. The ID team identified substantial issues for the affected resources to further focus the analysis. This EA addresses those site-specific impacts that were not disclosed within the PRB FEIS that would help in making a reasoned decision or may be related to a potentially significant effect. Issues for this project include:

- **Soils and Vegetation**: site stability, reclamation potential, invasive species, and riparian and wetland communities;
- **Wildlife**: raptor productivity, Greater Sage-Grouse lek occupancy and persistency, and health of the Fortification elk herd;
- **Cultural**: National Register eligible sites;
- **Water**: ground water depletion, quality, and quantity of produced water.
- **Economics:** projected natural gas production and revenue**.**

1.5.2.Public Review

A draft of this EA was sent to Wyoming Game & Fish Department (WGFD) February 11, 2015 for their review and an opportunity to comment on the project, potential impacts to the Fortification Elk herd and the adequacy of the mitigation to be implemented. BLM received no comments from WGFD.

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Two alternatives, A and B, were evaluated. A brief description of each alternative is included in the following sections.

2.1. Alternative A - No Action

The PRB FEIS considered a No Action Alternative, pp. 2-54 to 2-62. The PRB FEIS analyzed the reasonably foreseeable development rolling across the PRB of over 51,000 coal bed natural gas (CBNG) and 3,200 natural gas and oil wells. The no action alternative would consist of no new federal wells. This alternative would deny these APDs and /or POD requiring the operator to resubmit APDs or a POD that complies with statutes and the reasonable measures in the PRB RMP Record of Decision (ROD) in order to lawfully exercise conditional lease rights.

This alternative considers and aggregates the PRB FEIS effects analysis with the subsequent analyses and development from the following adjacent and/or overlapping PODs; See Table 2.1. The no action alternative would deny the KDUE2 APDs.

Table 2.1 Adjacent and/or Overlapping CBNG PODs

POD Name; Operator	Environmental Assessment #	Decision Date	Acres Surface Disturbance
Augusta Unit Zeta; Anadarko (Lance)	WY-070-EA08-154	7/22/2009	193
Kinney Divide Unit Gamma; Anadarko(Lance)	WY-070-EA10-271	8/26/2010	124
Kinney Divide Unit Epsilon; Anadarko(Lance)	WY-070-EA12-148	8/14/2012	112
Sahara POD; Anadarko (Lance)	WY-070-EA13-72	3/5/2013	125
Fortification Creek Planning Area Resource Management Plan Amendment (BLM)	WY-070-EA080 -135	8/5/2011	~2,092

2.2. Alternative B – Operator Proposed Action

Alternative B contains 16 complete APDs and is based on the BLM working with Anadarko to reduce environmental impacts. This alternative summarizes the POD as it was submitted to BLM by Anadarko on October 9, 2014 as revised following the onsite visits by Anadarko and BLM between June 11- 12 and August 12, 2014.

Proposed Action Title/Type: Anadarko E&P Onshore LLC's Kinney Divide Unit Epsilon 2 CBNG POD.

Proposed Well Information: There are 16 complete APDs within this POD; the wells are vertical bores proposed based on an 80-acre spacing pattern with 1 well per location. Each well will produce from Fort Union Coal seams (Wall coal) with the Werner, and Gates coal seams produced if present. Proposed well house dimensions are approximately 6 feet in width, 6 feet in length, and 4.5 feet in height and a meter house 4 feet in width, 4 feet in length, and 8 feet in height. Well and meter house color will be Covert Green, selected to blend with the surrounding vegetation. A list of proposed wells is included in Table 2.2.

Table 2.2 Complete APDs - Alternative B Well Descriptions

	Well Name	QTR	Sec	TWP	RNG	Lease
1	KDU Fed 11-19-5176	NWNW	19	51N	76W	WYW137646
2	KDU Fed 12-19-5176	SWNW	19	51N	76W	WYW137646
3	KDU Fed 22-19-5176	SENW	19	51N	76W	WYW137646
4	KDU Fed 41-22-5177	NENE	22	51N	77W	WYW146312
5	KDU Fed 11-23-5177	NWNW	23	51N	77W	WYW146311
6	KDU Fed 21-23-5177	NENW	23	51N	77W	WYW138448
7	KDU Fed 22-23-5177	SENW	23	51N	77W	WYW138448
8	KDU Fed 31-23-5177	NWNE	23	51N	77W	WYW138448
9	KDU Fed 41-23-5177	NENE	23	51N	77W	WYW138448
10	KDU Fed 43-23-5177	NESE	23	51N	77W	WYW138448
11	KDU Fed 11-24-5177	NWSW	24	51N	77W	WYW138448
12	KDU Fed 12-24-5177	SWNW	24	51N	77W	WYW138448
13	KDU Fed 13-24-5177	NWSW	24	51N	77W	WYW138448
14	KDU Fed 32-24-5177	SWNE	24	51N	77W	WYW146311
15	KDU Fed 41-24-5177	NENE	24	51N	77W	WYW146311
16	KDU Fed 51-24-5177	NENE	24	51N	77W	WYW146311

Drilling and Construction:

- Wells would be drilled to the Fort Union coal zones to depths ranging from 2,481 to 2,685 feet. Multiple seams would be produced by co-mingling production (a single well per location capable of producing from multiple coal seams) with the Werner, Gates and Wall coals being the targeted seams.

- Drilling and construction activities are anticipated to be completed within two years, the term of an APD. Drilling and construction occurs year-round in the PRB. Weather may cause delays lasting several days but rarely do delays last multiple weeks. Timing limitations in the form of COAs and/or agreements with surface owners impose longer temporal restrictions on portions of this POD, but rarely do these restrictions affect an entire POD.

- Well metering would be accomplished by individual well telemetry. No central metering facility is proposed. In addition to telemetry, BLM anticipates frequent (1 trip per day) well visits following initial well production dropping off over the first 3 to 6 weeks. Anadarko will limit well visitation as much as is practicable during crucial elk timing periods and anticipates an average of 1 well visit per week utilizing automation. This is to ensure the wells are operating correctly and there are no leaks undetected by telemetry. Maintenance operations will be scheduled outside of crucial elk timing periods when practical. See Appendix E, pp E-4 and E-5

- An existing and proposed road network consisting of the following:
  - 5.6 miles of proposed improved roads
  - 6.8 miles of existing unimproved roads

- Six (6) power drop locations consisting of a transformer and meter would be associated with this POD. Temporary generators are anticipated for this project for up to 2 years or until permanent electrical power is available.

- Utility corridors include buried gas, water, and power line networks; 5.6 miles are adjacent to proposed or existing roads.

Water Management: The Water Management Plan (WMP) describes that the CBNG produced water will be collected by buried pipelines and conveyed to the existing Barber Creek water treatment facility, located at NENW Section 9, T50N, R77W. Discharge will be to the Powder River, using existing Wyoming Department of Environmental Quality (WDEQ) permitted outfalls.

The Barber Creek water treatment facility and associated existing infrastructure listed in Table 2.4 was originally analyzed for use in Anadarko's (formerly Lance) Powder Valley Unit POD (WY-070-EA04-072). The permit associated with this facility and the facility itself has been modified since 2004; it has been renamed the River Road CBM Facility. The specific modifications pertinent to this project are listed below with the corresponding NEPA analysis.

Table 2.3 Existing Water Treatment Facility

Facility Name	NEPA Documents	WYPDES	Lease	Outfall	QTR	Sec	TWN	RNG
River Road CBM Facility	KDU Gamma POD; WY-070-EA10-271	WY0056081	WYW149359	046	SWSW	4	50	77
River Road CBM Facility	KDU Epsilon POD; WY-070-EA12-148	WY0056081	WYW146315	053	NENW	28	51	77

For a detailed description of design features, construction practices, and water management strategies associated with the proposed action, refer to the Surface Use and Operations Plan (SUPO), Drilling Plan, and WMP in the POD. POD maps show the proposed well locations and associated facilities described above. More information on CBNG well drilling, production and standard practices is available in the PRB FEIS, Volume 1, pp. 2-9 through 2-40 (USDI BLM 2003a).

Implementation of lease stipulations, committed mitigation measures contained in the SUPO, Drilling Program and WMP, and the Standard COAs contained in the PRB FEIS ROD Appendix A, are incorporated and analyzed in this alternative.

County: Johnson

Applicant: Anadarko E&P Onshore LLC

Surface Owners: The project area lies within T51N, R76W section 19; T51N/R77W sections 13, 22, 23 and 24. The majority of the land within the project area is privately owned, with BLM parcels interspersed. Privately owned lands comprise approximately 67 percent of the project area; approximately 33 percent of the land within the POD is managed by the BLM. Powder River Ranch, Inc. owns the private holdings within the project area. The landownership pattern is displayed on the Project maps.

2.3. Summary of Alternatives

A summary of the infrastructure currently existing within the POD area (Alternative A) and the infrastructure included in Alternatives B are presented in Table 2.4.

Table 2.4 Disturbance Summary for KDUE2

Facility	Number or Miles	Factor	Acres Disturbance
Existing Unimproved Roads	6.8 miles	~15 feet	12.4
Existing Overhead Powerlines	2.4 miles	30 feet	8.7
Proposed Disturbance			
Engineered Pads	10	Varies	7.65
Rig Slots	1	0.5 acre	0.5
Non-constructed well sites	5	0.5 acre	2.5
Improved Roads With Utility Corridor	3.78 miles	45 feet	20.66
Engineered Roads With Utility Corridor	1.85 miles	50 feet	11.23
Utility Corridor not with Access Road	0 miles	0 feet	0
Total Surface Disturbance			**42.54 acres**

2.4. Alternatives Considered but Not Analyzed in Detail

Alternatives considered but not analyzed in detail are disclosed in the FCPA-RMPA pages 2.6–2-10.

2.5. Conformance

The proposed action conforms to the 1985 Buffalo RMP, the 2001, and 2011 amendments, and the 2003 PRB FEIS and RMP Amendment and ROD. The proposed project conforms to federal laws, regulations, and policies including FLPMA, the National Historic Preservation Act, the Endangered Species Act, the Migratory Bird Treaty Act, the Clean Water Act, the Clean Air Act, the National Environmental Policy Act and DOI Order 3310.

3. AFFECTED ENVIRONMENT

This section describes the environment affected by implementation of the alternatives described in Section 2 of this document. Aspects of the affected environment described in this section focus on the relevant major issues. A screening of all resources and land uses potentially affected by the proposed project is included in Appendix B of this document. Resources that would be unaffected, or not affected beyond the level analyzed within the PRB FEIS, are not discussed within this EA.

3.1. Project Area Description

The POD would be developed within an area of approximately 1,840 acres in Johnson County, Wyoming. Elevations range from 3,900 to 4,600 feet above sea level (BHEC 2014).

Topography ranges from moderately to extremely rugged with steep ridgelines and deeply incised draws. Much of the project area consists of dissected uplands with steep down-cut channels, created predominately by summer thunderstorms and spring runoff in ephemeral drainages with steep gradients and fine sediment substrate, which lead to the Powder River. The overall project area is managed as rangeland, with livestock grazing and recreational hunting as the main uses. The area contains historic conventional oil and gas production, and more recently, CBNG development.

Alluvial and colluvial deposits consist of gradational and dissected alluvial fans (USDI BLM 2009). The underlying bedrock within the project area consists entirely of the Wasatch Formation. Within the vicinity of the project area, the Wasatch Formation is primarily variegated mudstone with sandstone and conglomeratic lenses (Love and Christiansen 1985).

The Wasatch Formation is underlain by the Fort Union Formation, which is further subdivided into three different members. The upper member of the Fort Union Formation, the Tongue River Member, is known to contain thick, continuous coal beds, including the Anderson-Wyodak coal zone (Bartos and Ogle 2002). The Big George coal seam is considered a deeper equivalent to the Anderson-Wyodak coal zone within the Fort Union Formation (Bartos and Ogle 2002).

The KDUE2 project area is split by Kinney Divide with the eastern end of the project area drained by Fortification Creek watershed via Livingston Draw. The western two-thirds of the POD drain to the Turner Draw-Powder River watershed with Turner Draw running through the southwest corner of the project area. Taylor Draw drains the northern edge of the POD. Intermittent streams flow through portions of the project area.

Development potential exists for salable minerals, including sand and gravel deposits (USDI BLM 2009). Salable minerals are mined from surface deposits and outcrops.

The KDUE2 project area is adjacent to the boundaries of 3 approved Federal CBNG PODs (Table 2.1). There are 390 oil and gas wells including 135 Federal wells (30 are plugged and abandoned) within a 4-mile radius of this proposal (WOGCC 10/14/2014) There is 1 approved APD within the project area and 1 plugged and abandoned oil well. The oil and gas development to the east, south, and west of the project area is extensive while the area to the north has little, if any, development.

An existing main oil and gas access road connects to the east end of the POD through Section 30 T51N, R76W via Kinney Divide Road and was analyzed in the Augusta Unit Zeta POD EA; See Tables 2.1 and 3.1.

Due to the proximity and similar nature of effect resources (i.e., steep slope, fragile soils and elk security habitat), the KDUE2 analysis incorporates by reference the project level NEPA documents list below in Table 3.1.

Table 3.1 This Project Incorporates by Reference these Project Level NEPA Documents.

POD Name; Operator	Environmental Assessment #	Decision Date
Augusta Unit Zeta; Anadarko (Lance)	WY-070-08-154	7/22/2009
Kinney Divide Unit Gamma; Anadarko (Lance)	WY-070-EA10-271	8/26/2010
Kinney Divide Unit Epsilon; Anadarko	WY-070-12-148	8/14/2012
Camp John Unit SMA 1 (Year 1); Anadarko	WY-070-EA11-214	11/4/2011
Camp John Unit SMA 1 (Year 2); Anadarko	WY-070-EA12-084	3/13/2014

3.2. Air Quality

The PRB FEIS, pp. 3-291 to 3-299, describes air quality conditions within the Powder River Basin prior to 2003. BLM incorporates by reference, Update of Task 3A Report for the Powder River Basin Coal Review Cumulative Air Quality Effects for 2020, BLM (AECOM), 2009, (Cumulative Air Quality Effects, 2009) as it captures the cumulative air quality effects of present and projected PRB fluid and solid mineral development. The Environmental Protection Agency (EPA) established ozone standards in 2008, finalizing them in 2011.

Existing air quality in the PRB is "unclassified/attainment" with all ambient air quality standards. It is also in an area that is in prevention of significant deterioration zone. PRB air quality is a concern due to air quality alerts issued in 2011 for particulate matter (PM), attributed to coal dust.

Four sites monitor air quality in the PRB: Cloud Peak in the Big Horn Mountains, Thunder Basin northeast of Gillette, Campbell County south of Gillette, and Gillette. In addition, the Wyoming Air Resource Monitoring System (WARMS) measures meteorological parameters from 6 sites, particulate concentrations from 5 sites, speciated aerosol from 3 sites, and evapotranspiration rates from 3 sites. The WARMS sites are at Sheridan, Fortification Creek, South Coal Reservoir, Buffalo, Juniper, and Newcastle. A northeast Wyoming visibility study is in progress conducted by the Wyoming Department of Environmental Quality (WDEQ). Sites adjacent to the Wyoming PRB-area are at Birney on the Tongue River 24 miles north of the Wyoming-Montana border, Broadus on the Powder River in Montana, and Devils Tower.

Existing air pollutant emission sources in the region include:

- Exhaust emissions (primarily CO and nitrogen oxides (NOx)) from existing natural gas fired compressor engines used in production of natural gas and CBNG; and, gasoline and diesel vehicle tailpipe emissions of combustion pollutants;
- Particulate matter (PM), dust generated by vehicle travel on unpaved roads, windblown dust from neighboring areas, road sanding during the winter months, and coal mines and trains;
- Transport of air pollutants from emission sources located outside the region;
- NOx, PM, and other emissions from diesel trains and,
- Sulphur dioxide (SO2) and NOx from power plants.

3.3. Transportation

There are nearly 6.8 miles of existing access roads though the project area that are a combination of constructed (flat bladed and/or bench cut) and primitive roads averaging 15 feet wide used primarily for livestock operations and recreational hunting including those roads across BLM surface. Approximately 1.2 miles lie across BLM surface. These roads have no drainage structures (ditches, culverts, etc.) to control runoff and are experiencing accelerated erosion in the form of rutting, riling and gullying.

BLM analyzed approximately 3 miles of the existing main access road and utility corridor to the project area in the Augusta Unit Zeta POD, incorporated here by reference, through Sections 19, 29, 30 and 32, T51N/R76W and Section 19, T51N/77W. The crowned and ditched roads were mechanically constructed and have been maintained in fair condition by the Operator. The crown and ditch roads have a 12-14 feet travel width with a sub-grade of 14-16 feet; some with surfacing material. Where slope and grade are minimal (less than 15% slope and 7% grade), the ditches are well vegetated they are approximately 6 inches deep with some visible scouring. Ditches on steep slopes and grade (16% slope and 8% grade or greater) are typically not well vegetated, erosion is occurring and scouring is 6 to 12 inches. There are several spots where greater rutting has occurred on the running surface due to minimal compaction. A majority of the existing culverts are 18 inches, made of corrugated metal, and are generally in good condition. Several culverts on existing oil and gas roads require maintenance to clean them out. The maximum grade on these roads is 16%.

3.4. Soils and Vegetation

Information on major land resource areas and soil types was obtained from Natural Resources Conservation Service (NRCS) information, including the Land Resource Regions and Major Land Resource Areas of the United States (U.S.), the Caribbean, and the Pacific Basin, U.S. Department of Agriculture (USDA) Handbook 296 (USDA 2006) and the Soil Survey Geographic Database (SSURGO). Soil baseline characterization for the project area is based on SSURGO database review and analyses. SSURGO is the most detailed level of soil mapping done by the USDA NRCS. Soils in the POD boundary were identified from the North Johnson County Survey Area, Wyoming (WY705). The NRCS performed the survey using National Cooperative Soil Survey standards.

The BLM uses SSURGO soil survey information to predict soil behavior, limitations, and suitability for a given action. The BLM's long term goal for soil resource management is to maintain, improve, or restore soil health and productivity, and to prevent or minimize soil erosion and compaction. Soil management objectives are to ensure that adequate soil protection is consistent with the resource capabilities.

The POD is located within the Southern Part of the Northern Rolling High Plains Major Land Resource Area (MLRA). This area is in the Missouri Plateau, Unglaciated Section of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that are deeply eroded. Typically, local relief is about 150 to 250 feet. Slopes generally are gently rolling to steep, with wide belts of steeply sloping badlands bordering the Powder River Valleys. Terraces are common in areas along the river system. In places, flat-topped, steep-sided buttes rise sharply above the plains.

Soils differ with topographic location, slope, and elevation. Soil depths vary from deep in the draw and creek bottoms to shallow in the uplands with very shallow soils on steeper slopes and ridge tops. Topsoil depths that can be salvaged for reclamation range from 0 inches on miscellaneous areas (such as badlands) to 2 inches on ridges and side slopes to 6 or more inches in bottomlands. Slopes vary, with steep slopes occurring primarily along drainages. The primary soil limitations in the project area are depth to bedrock, low organic matter content, low water holding capacity, and high water erosion potential.

The dominant soil orders in this MLRA are Aridisols and Entisols. Aridisols are well developed soils that have a very low concentration of organic matter and form in an arid or semi-arid climate. In contrast, Entisols are considered recent soils that lack soil development because erosion or deposition rates occur faster than the rate of soil development. Soils in the project area have developed in alluvium and residuum derived mainly from the Wasatch Formation. Lithology consists of light to dark yellow and tan siltstone and sandstones with minor coal seams.

The project area contains 20 soil map units. A map unit consists of the named soils or miscellaneous areas that are dominant or co-dominant in extent. Map units may also contain large areas of similar soils or miscellaneous areas not as extensive as the named components, and minor inclusions (dissimilar soils or miscellaneous areas that are minor in extent). The soil series is the most specific category of the national soil classification system, commonly used to designate soil map units. Soil series describe soils that have similar chemistry, physical properties, and perform similarly for land use purposes. Dominant soil map units found within the POD boundary are listed in Table 3.2. Soil map units representing one percent or greater are identified.

Table 3.2 Dominant Soils Affected by the Proposed Action

Map Unit Symbol	Map Unit Name	Acres	% Project Area
684	Samday-Shingle-Badland complex, 10 to 45 percent slopes	1,215	66
656	Hiland-Bowbac fine sandy loams, 6 to 15 percent slopes	202	11
707	Theedle-Kishona loams, 6 to 20 percent slopes	201	11
708	Theedle-Kishona-Shingle loams, 3 to 30 percent slopes	116	6
709	Theedle-Shingle loams, 3 to 30 percent slopes	70	4
614	Forkwood loam, 0 to 6 percent slopes	36	2

The map unit that makes up the majority of the project area (66 percent) also has the most limiting chemical and physical soil properties, Samday-Shingle-Badland complex (10 to 45 percent slopes). Topsoil depth ranges from 0 to 6 inches with low organic content of 0 to 2 percent. The soil has a slightly sodic horizon within 30 inches of the surface. The badland component is of greatest concern due to the lack of soil, vegetation, and a predominance of steep slopes with high erosion potential. Often badlands are comprised of slightly weathered bedrock. Typically, badlands are difficult, if not impossible, to reclaim. However, inclusions of very shallow soil areas are especially typical of these map units and are equally limiting.

The soils of the other 5 map units have a fair rating as a source of reclamation material. Whereas Samday-Shingle-Badland complex have a poor rating as a source of reclamation material (droughty, shallow depth to bed rock, too clayey, low organic matter, low strength, too steep, prone to water erosion). Soils found within the map units are poorly rated as construction material sources except for Hiland and Forkwood.

Additional soil information is included in the ecological site descriptions. Ecological site descriptions are soil and vegetation community descriptions compiled by the NRCS for the purpose of resource identification providing management and reclamation recommendations (provided below).

3.4.1 Soils Susceptible to Erosion

Productivity loss is likely to occur on disturbed soils if erosion is not effectively controlled. The development of a favorable rooting zone by the weathering of parent rock is much slower than development of the surface horizon. One estimate of this renewal rate is 0.5 tons per acre per year for unconsolidated parent materials and much less for consolidated materials. Loss of organic matter, resulting from erosion and tillage, is one of the primary causes for reduction in production yields. As organic matter decreases, soil aggregate stability, soil moisture holding capacity, and cation exchange capacity decline (USDA 1998). The Samday-Shingle-Badland complex (10 to 45 percent slopes) also has a severe erosion hazard rating with components occurring at 35, 30, and 15 percent respectfully. This high erosion potential could result in higher suspended sediment and turbidity levels in the Powder River. The NRCS (2011) soil interpretations indicate that the soils within the map unit areas range from moderate to high susceptibility to water erosion and moderately resistant to wind erosion. Once disturbed, these same soils prone to severe water erosion become prone to severe erosion by wind as well.

Table 3.2 shows the relative erosion potential, based on the site-specific information discussed above.

Table 3.3 Erosion Potential within the KDUE2 Project Area

Erosion Potential	Acres	Percent of Project Area
High	1,215	66
Moderate	625	34

Source: USDA 2010a.

3.4.2 Limited Reclamation Potential

There are areas (e.g., alkaline soils, badlands, shale blowouts and rocky outcrops) where reclamation, by conventional standards, may not be achievable. These limited reclamation potential (LRP) areas are characterized by highly erodible soils, steep slopes, sites having physical, biological, and/or chemical limitations, low precipitation rates, or areas which have characteristics that make traditional reclamation practices impractical or unfeasible. Because successful reclamation in LRP areas is extremely difficult if achievable at all, LRP areas should be avoided.

Soil scientists identify LRP soils using SSURGO Data and onsite investigation; approximately 1,178 acres of LRP soils have been identified within the project area, or 64% of the project area.

The operator provided a soil assessment included in KDUE 2 POD Reclamation Plan. The assessment and onsite investigation found four types of LRP areas within the project boundary.

1. Miscellaneous areas: have essentially no soil and support little or no vegetation and include sand blowouts which have low potential for restoration, high susceptibility for site degradation, and poor reclamation suitability. They can result from active erosion, washing by water, unfavorable soil conditions, or human activities. Some miscellaneous areas can be made productive, but only after major reclamation efforts. (430-VI-NSSH, 1996)
2. Badlands: A landscape which is intricately dissected and characterized by a very fine drainage network with high drainage densities and short, steep slopes with narrow interfluves. Badlands develop on surfaces with little or no vegetative cover, overlying unconsolidated or poorly cemented materials (clays, silts, or in some cases sandstones) sometimes with soluble minerals such gypsum or halite (430-VI-NSSH, 1996).
3. Rock outcrop: Consists of exposures of bare bedrock. Most rock outcrops are hard rock, but some are soft. (430-VI-NSSH, 1996)
4. Slopes in Excess of 25%: Slopes usually increase the potential for slumping, landslides and water erosion (see chapter heading below Slopes in Excess of 25 Percent for complete description).

3.4.3 Slope in Excess of 25 Percent

A soil's stability is greatly affected by the slope on which it occurs. In general, the greater the slope, the greater the potential is for slumping, landslides, and water erosion. Approximately 872 acres (47%) in the project area have slopes of 25 percent or more.

Soils with slopes of less than 25 percent may also be prone to high erosion due to the soil type, particle size, texture, or amount of organic matter. Soil types in the POD boundary with severe erosion potential and slopes 25 percent or greater, as defined by the NRCS (USDA 2010a), are listed in Tables 3.3 and 3.4, respectively, along with the number of acres and percentage of the project area.

Other contributing factors to slope stability include slope length, slope aspect, and colluvium. Slope length considerably influences runoff and water erosion. Slope aspect is the direction which the surface of the soil faces, which affects soil temperature, evapotranspiration, wind contact, and soil moisture. Colluvium is poorly sorted debris that has accumulated at the base of slopes, in depressions, or along small streams through gravity, soil creep, and local wash. It consists largely of material that has migrated down the slope under the influence of gravity. The rock fragments in colluvium are usually angular, in

contrast to the rounded, water-worn cobbles and stones in alluvium and glacial outwash (Soil Conservation Service 1993). The predominant colluviums in the POD boundary are angular fractured shales and limestone. These factors in combination with slope determine soil stability and the potential for mass soil movement.

Table 3.4 Percent Slope within the KDUE2 Project Area

Percent Slope	Acres	Percent of Project Area
0-24%	968	53
≥ 25%	872	47

3.4.3.1. Reclamation Suitability (Source Material)

Soils with poor reclamation and re-vegetation suitability occur where there is a poor source of reclamation material. These areas occur throughout the project area as shown in Table 3.4. Currently, soil conditions in the project area are being impacted by CBNG development as well as traditional activities, including livestock grazing and wildlife use. Much of the area is covered with soils that are easily damaged by use or disturbance or are difficult to revegetate or otherwise reclaim. Soil impacts (e.g., roads, linear pipeline scars, and artificial wet areas) can be readily observed in the area.

Table 3.5 Reclamation Potential within the KDUE2 Project Area

Reclamation Potential	Approximate Acres	Percent of Project Area
Fair	625	34
Poor	1,215	66

Source: USDA 2010a.

In the absence of recoverable topsoil, as is common throughout the project area, the surface organic matter in the form of vegetation, litter, and biological crust are critical to maintaining the integrity and viability of the soil. The map unit most representative of poor reclamation source material is 684, Samday-Shingle-Badland complex, 10 to 45 percent slopes.

Reclamation potential of soils varies throughout the project area. The main soil limitations in the project area include: depth to bedrock, low organic matter content, and high erosion potential especially in areas of steep slopes. Many of the soils and landforms of this area present distinct challenges for development. Approximately 66 percent of the area within the boundary of the proposed action contains soil map units with a named component identified as being highly susceptible to water erosion and 66 percent contain soils poorly suited for reclamation. Approximately 47 percent of the area has slopes 25 percent or greater making stabilization of disturbance and reclamation challenging and possibly unachievable in certain areas if disturbed by the proposed project.

Eighty-seven (87) percent of the surface and subsurface soils within the project area are rated as poor construction material sources for road fill making the integrity of roads constructed from this native material questionable due to steep slopes, shallow depth to bedrock, and low soil strength.

3.4.4. Vegetation and Ecological Sites

Ecological site descriptions provide site and vegetation information needed for resource identification, management, and reclamation recommendations. To determine the appropriate ecological sites for the area contained within this proposed POD, BLM specialists analyzed data from on-site field reconnaissance and from NRCS published soil survey information. A summary of the ecological sites within the project area and their corresponding map units, approximate acreage, and percentage of the total area identified within the POD boundary are listed in Table 3.5.

Table 3.6 Ecological Sites and Soils Map Units within the KDUE2 Project Area

Map Unit	Ecological Site	Approximate Acreage[1]	Percent of Project Area
684	Shallow Clayey (10-14NP)	1,215	66
707	Loamy (10-14NP)	423	23
708			
709			
614			
656	Sandy (10-14NP)	202	11

Source: USDA 2010a.

Dominant ecological sites and plant communities identified in this POD include shallow clayey (10-14NP), loamy (10-14NP), and Sandy (10-14NP) sites respectfully. Minor ecological sites and plant communities identified as areas that are difficult to reclaim include sands and sandy sites. In addition, within the project area are small inclusion areas of very shallow parent material (ten inches or less deep). Typically, indicators of shallow soils are found in these locations such as little bluestem and juniper. Tables 3.2, 3.3, 3.4, 3.5 and 3.6 demonstrate the diversity of soil types and structure found within the 1,840 acre project area.

The loamy (10-14NP) ecological site (covering approximately 23 percent of the POD) is a rangeland site type, found in the Northern Rolling High Plains. Composed of gently undulating rolling lands, this ecological site receives approximately 10 to 14 inches of annual precipitation and consists of well-drained, moderately permeable, and deep to moderately deep soils. The dominant species found within this ecological site include western wheatgrass, needle-and-thread, green needlegrass, Cusick's bluegrass, Sandberg bluegrass, bluebunch wheatgrass, and blue grama. Wyoming big sagebrush typically comprises 15 percent of the vegetation community. Disturbances such as overgrazing and changes in the fire regime lead to changes in the vegetation community. Overgrazing increases Wyoming big sagebrush and blue grama while cool season grasses decrease. The absence of fire can increase the cover and percentage of Wyoming big sagebrush on the site, until it becomes the dominant species. Disturbances can also lead to increases in cheatgrass, western wheatgrass, and plains pricklypear (USDA 2010a).

The sandy (10-14NP) ecological site (covering approximately 11 percent of the POD) is a rangeland site type, found in the Northern Rolling High Plains. Found on slope and benches, this ecological site receives approximately 10 to 14 inches of annual precipitation and consists of consists of well-drained, permeable, and deep to moderately deep soils. The bedrock is characterized as sandstone bedrock, which is penetrable to plant roots. Textures range from silty to sandy loam. The dominant species found within this ecological site include cool-season midgrasses, such as wheatgrass, Sandberg bluegrass, threadleaf sedge, blue grama, little blue stem, sand reed and Indian rice. Dominant shrub species include Wyoming big sagebrush and yucca. Disturbances can lead to increases in blue grama and Wyoming big sagebrush; and decreases in green needlegrass, bluebunch wheatgrass, and rhizomatous wheatgrasses (USDA 2010a).

The predominant vegetation community types in the project area are mixed-grass prairie and sagebrush shrubland. Species typical of the mixed-grass prairie community type consist of western wheatgrass, blue grama, needle-and-thread, prickly pear cactus, scarlet globemallow, and Wyoming big sagebrush. Species typical of the sagebrush shrubland community type include silver sagebrush, western wheatgrass, prairie junegrass, Sandberg bluegrass, prickly pear cactus, and rabbitbrush (USDI BLM 2003a, USDA 2010a, Anadarko 2011). Inclusions within the dominant ecological sites are very shallow sites dominated by little bluestem and juniper trees. Steady encroachment of junipers is overtaking the prairie grass/shrubland community in much of the upland area. Species nomenclature is consistent with the NRCS Plants

Database (USDA 2010a). A full list of species expected to be found in the project area are included in the FCPA RMPA, Appendix 6, pages 26-27.

The site visits conducted June and August 2014 confirmed the dominant vegetation communities and the presence of the typical species. In addition, other native species observed include Sandberg bluegrass, threadleaf sedge, spiny phlox, common yarrow, and greasewood. In some locations, cheatgrass is the dominant species present.

The site visits also confirmed the presence of tree species in draws, along the creeks, and at higher elevations of the project area. In many of the tributaries to Turner Draw, juniper is prevalent with some ponderosa pine as well, while cottonwoods, willows and salt cedar are scattered along the Powder River in the riparian corridor. At higher elevations, ponderosa pine also occurs.

An important component of soils in Wyoming's semiarid rangelands, especially in the Wyoming big sagebrush cover type, are biological soil crusts, or cryptogrammic soils that occupy ground area not covered with vascular plants. Biological soil crusts are important in maintaining soil stability, controlling erosion, fixing nitrogen, providing nutrients to vascular plants, increasing precipitation infiltration rates, and providing suitable seed beds (Belnap et al. 2001). They are adapted to growing in severe climates; however, they take many years to develop (20 to 100 years). Biological crusts are present in the project area, particularly in areas with shallow and very shallow soils. These crusts have not been well studied in the area, so their current extent or survival trend is unknown.

3.5. Water Resources

The PRB FEIS (USDI BLM 2003a) identifies 1 'subwatershed' in its study area, this POD falls within the Upper Powder River subwatershed. See Surface Water section for additional information.

Turner Draw and Lower Fortification Creek are the main project area tributaries to the Upper Powder River. The USGS operates stream gauges on the Powder River approximately 12.5 air miles downstream (USGS Site No. 0631700) of the Fortification Creek confluence.

The WDEQ assumed primacy from U.S. Environmental Protection Agency for maintaining the water quality in the waters of the State. The Wyoming State Engineer's Office (WSEO) has authority for regulating water rights issues and permitting impoundments for the containment of surface waters of the state. The Wyoming Oil and Gas Conservation Commission (WOGCC) has authority for permitting and bonding off-channel pits that are located over State and fee minerals.

3.5.1. Groundwater

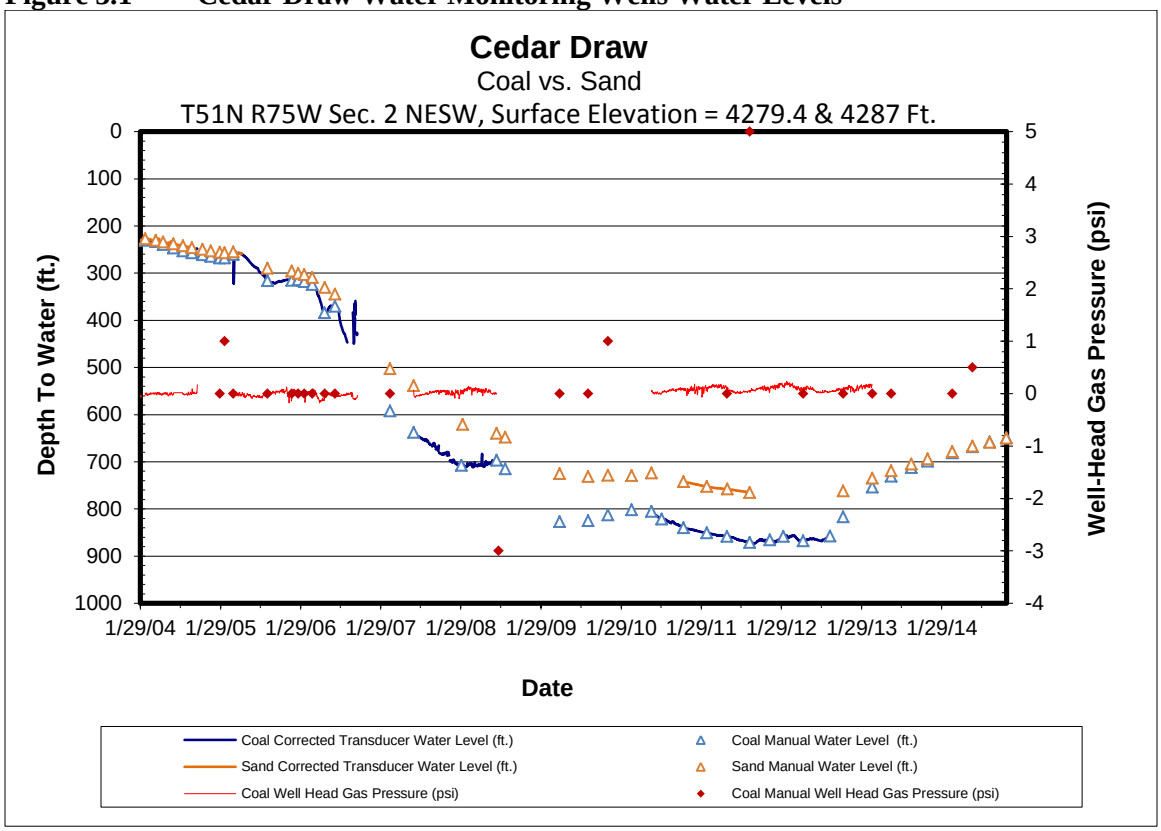
The groundwater in this project area historically has been used for stock water or domestic purposes. A search of the WSEO Ground Water Rights Database for this area showed 8 registered stock and domestic water wells within a 1 mile radius of the proposed POD wells. Well depths range from 420 to 1,010 feet with static water levels in the wells at the time of their initial production from 2 to 40 feet below ground surface. For additional information on groundwater, please refer to the PRB FEIS (USDI BLM 2003a), Chapter 3, Affected Environment pp. 3-1 through 3-36 (groundwater).

WDEQ water quality parameters for groundwater classifications (WDEQ 2005) define the following general limits for Total Dissolved Solids (TDS): 500 milligrams per liter (mg/l) TDS for Drinking Water (Class I), 2,000 mg/l for Agricultural Use (Class II), and 5,000 mg/l for Livestock Use (Class III). For additional water quality limits for groundwater, please refer to the WDEQ web site.

The production of CBNG necessitates the removal of water saturation in the coal zones to temporarily reduce the hydraulic head in the coal. The BFO has been monitoring coal zone pressures as expressed in

depth to water from surface since the early 1990s in the PRB. The Cedar Draw groundwater monitoring well is located in the NESW Sec 2, T51N/R75W. Figure 3.1 shows that the initial water level in the Wall Coal was 230.8 feet below ground surface (bgs) on February 20, 2004. The most recent measurement, dated November 19, 2014 recorded the water level at 649.5 feet bgs. On August 12, 2012, the groundwater levels in this monitor well declined to a low of 868.3 or 637.5 feet below the initial reading taken when the well was completed. Since that time, the water levels have recovered by 218.8 feet, probably due to suspension of production in the area due to low gas prices. The Wasatch Sand well at the Cedar Draw monitoring well location has also shown a decrease in groundwater elevations. The initial sand well reading on January 29, 2004 showed the groundwater level in the sand well to be at 229.5 feet bgs and the lowest water level reading, collected on November 7, 2011 shows the groundwater level to be at 765.4 feet bgs. This is a drop in groundwater levels within the Wasatch Sands of 532.7 feet. The most recent level taken November 19, 2014 was 650.3 feet bgs for a recovery of 115.1 feet.

Figure 3.1 Cedar Draw Water Monitoring Wells Water Levels



For additional information, please refer to the PRB FEIS Chapter 4 Groundwater and the Wyoming State Geological Survey's Open File Report 2009-10 titled "1993-2006 Coalbed Natural Gas (CBNG) Regional Groundwater Monitoring Report: Powder River Basin, Wyoming," which is available on their website at http://www.wsgs.uwyo.edu.

3.5.2. Surface Water

The project area is within the Turner Draw and Lower Fortification Creek 12th order watersheds which drain to the Powder River in the Upper Powder River sub-watershed. Most of the waterways in the area are ephemeral (flowing only in response to a precipitation event or snow melt) to intermittent (flowing only at certain times of the year when it receives water from alluvial groundwater, springs, or other surface source – PRB FEIS Chapter 9 Glossary). Drainage features consist of narrow ephemeral draws,

steep-sided gullies in various stages of stability or active erosion, and broader meandering streams in alluvial valleys. Both Turner Draw and Fortification Creek may have intermittent flows supported by groundwater contributions during part of the summer. Stratified alluvial deposits of silts and sands occur along the major streams, supporting sagebrush and grasses. Vegetation contributes to stabilizing the drainage network in many parts of the project area and surrounding locale.

A water rights search using the Wyoming State Engineer's Office (SEO database) and the USGS 1:24,000 scale quad maps indicated that no natural springs exist within one mile of the KDUE 2 POD (Anadarko 2014).

The PRB FEIS presents the historic mean Electrical Conductivity (EC) in (micromhos per centimeter) and Sodium Adsorption Ratio (SAR) by watershed at selected USGS Gaging Stations in Table 3-11 of the PRB FEIS (p. 3-49). These water quality parameters "illustrate the variability in ambient EC and SAR in streams within the Project Area. The representative stream water quality is used in the impact analysis presented in Chapter 4 as the baseline for evaluating potential impacts to water quality and existing uses from future discharges of CBM produced water of varying chemical composition to surface drainages within the Project Area" (PRB FEIS p. 3-48). For the Upper Powder River, the EC ranges from 1,797 at maximum monthly flow to 3,400 at low monthly flow and the SAR ranges from 4.76 at maximum monthly flow to 7.83 at low monthly flow. These values were determined at the USGS station "Powder River at Arvada, WY" (PRB FEIS p. 3-49).

For more information regarding surface water, please refer to the PRB FEIS Chapter 3 Affected Environment pp. 3-36 through 3-56.

3.6. Wetlands/Riparian

Based on National Wetland Inventory (NWI) data interpreted from the BLM GIS maps, there is approximately 0.75 acres of wetland riparian habitat present within the KDUE 2 POD boundary. Wetland types represented in the POD boundary are Freshwater Emergent (0.32 acres) and Freshwater Pond (0.43 acres). For additional discussions on surface water refer to the PRB FEIS (pp. 3-36 to 3-56).

3.7. Noxious Weeds and Invasive Species

The introduction, spread, and proliferation of noxious weeds and invasive plant species is an increasing concern on both public and private lands. The State of Wyoming defines noxious weeds as weeds, seeds, or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within the State, and are on the designated list by the Wyoming Statutes (Title 11, Chapter 5, Section 102.a.xi). Invasive plant species are non-indigenous species, or "non-native", plants or animals that adversely economically, environmentally, and/or ecologically affect the habitats and bioregions they invade. They typically out-compete native species as they lack natural controls (i.e.: predators or herbivores).

Pursuant to the Wyoming Weed and Pest Control Act of 1973, a total of 24 plant species are defined as designated and prohibited noxious weed species (Designated Noxious Weeds W.S. 11-5-102 (a)(xi) and Prohibited Noxious Weeds W.S. 11-12-104, as listed in Table 3-21 of the PRB FEIS; p. 3-104). Since the publication of the PRB FEIS (USDI BLM 2003a), Russian olive (*Elaeagnus angustifolia*), common St. Johns wort (*Hypericum perforatum*), and common tansy (*Tanacetum vulgare*) have been added to the Wyoming Weed and Pest Control Act designated and prohibited noxious weed species list (Wyoming Department of Agriculture 2010). In addition, Table 3-22 of the PRB FEIS (p. 3-15) lists known occurrences of weed species of concern that may be present within the project area (USDI BLM 2003a).

Pursuant to the KDUE 2 POD Integrated Weed and Pest Management Plan (IPMP), the following eight noxious weeds and invasive plant species have been targeted for management within the project area:

leafy spurge (*Euphorbia esula*), saltcedar (*Tamarix ramosissima*), common cocklebur (*Xanthium strumarium*), buffalo bur (*Solanum rostratum*), Canada thistle *(Cirsium arvense*, Russian knapweed *(Centaurea repens L.*), Scotch thistle (*Onopordum acanthium L.*), culycup gumweed (*Grindelia squarrosa*) (Anadarko 2014). Infestations of Canada thistle *(Cirsium arvense)* were observed within the project area during field visits primarily along drainage bottoms and areas where the vegetation had previously been removed by surface disturbing activities or fire.

In October 2010 Anadarko proposed an imazapic treatment (chemical applied by aerial and ground) to reduce infestations of cheatgrass within the FCPA across 5,000 acres in the Southeast Development Phase of the FCPA. The project was designed to remove cheatgrass in order to increase the habitat values for wildlife. Spraying specifically targeted T51N, R75W Sections 5, 6, 7, 8, 9, 15, 19, 20, 22, 27, 28, 29, 30, 31, 32, 33 and T50N, R75W Section 6. The proposal was analyzed under Environmental Assessment WY-070-EA11-217 (approved July 18, 2011). Treatment was initiated in September of 2011. Post application vegetation monitoring in 2011-2014 is being reviewed by Anadarko to determine the treatment effectiveness.

3.8. Wildlife

Several resources were consulted to identify wildlife species that may occur in the project area. Resources that were consulted include the wildlife database compiled and managed by the BFO wildlife biologists, the PRB FEIS, the Wyoming Game and Fish Department (WGFD) big game and Greater Sage-Grouse maps, the Fortification Creek Planning Area RMPA/EA, and the Wyoming Natural Diversity Database (WYNDD). Wildlife inventory surveys were performed by Big Horn Environmental Consultants for Anadarko from 2007 to 2014. Species specific surveys included sharp-tailed grouse, Greater Sage-Grouse, raptor nests, bald eagle nests and winter roost sites, prairie dog colonies, mountain plover, and habitat for the Ute ladies'-tresses orchid.

WGFD has developed several guidance documents that the BFO wildlife staff relies upon in evaluating impacts to wildlife and wildlife habitats.

In its *Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats* (WGFD 2009b), WGFD recommended impact thresholds to evaluate impacts to wildlife from oil and gas development. For species or habitats discussed in this EA, those thresholds will be disclosed and discussed both in relation to the current conditions (Affected Environment) and in relation to reasonable foreseeable development, including development associated with the proposed project (Environmental Effects). Moderate impacts occur when impairment of habitat function becomes discernible. High impacts occur when impairment of habitat function increases. Extreme impacts occur where habitat function is substantially impaired. Mitigation for each level of impact is identified in the guidelines. Thresholds for impacts generally are determined by well density.

3.8.1. Habitat Types

The project area is predominantly mixed grass prairie and sagebrush shrubland. Sagebrush is interspersed with native short-grass species including blue gramma. Juniper is prevalent in many draws throughout the area with scattered individual ponderosa pines and dense juniper groves occurring in the higher elevations. Cottonwood trees and riparian vegetation along the Powder River riparian corridor are visible in the distance from the west end of the project area. These habitat types are displayed in Figures 3.2 below. For more details on habitat types, refer to the Vegetation section above.

Figure 3.2 Photo Representative of the Habitat Types within the KDUE 2 Project Area

The type of available wildlife habitat found within the project area is defined by the roughness of the topography. Topography ranges from moderately to extremely rugged with steep ridgelines and deeply incised draws. Much of the project area consists of dissected uplands with steep down-cut channels, created predominately by summer thunderstorms and spring runoff in ephemeral drainages with steep gradients and fine sediment substrate, which lead to the Powder River.

3.8.2. Big Game

3.8.2.1. General

Big game species expected to occur within the KDUE 2 POD include pronghorn antelope, mule deer, white-tailed deer, and elk. The affected environment for pronghorn is discussed in the PRB FEIS, pp. 3-117 to 3-122, while-tailed deer on pp. 3-122 to 3-127, and for mule deer, pp. 3-127 to 3-132. Big game range maps are available in the PRB FEIS, pp. 3-119 to 3-143. The project area supports crucial winter and parturition range for the Fortification elk herd.

The affected environment for the Fortification elk herd is discussed in the PRB FEIS, pp. 3-132 to 3-140 and in the FCPA RMPA, pp. 3-27 to 3-32. The PRB FEIS generally considered cumulative impacts to elk but did not specifically address the Fortification elk herd. The FCPA RMPA addresses cumulative impacts to the Fortification elk herd resulting from CBNG development within the herd's entire yearlong range. CBNG development is proposed throughout and surrounding the elk herd's seasonal ranges.

3.8.2.2. Elk

In 1992, a 2.5 year study of the Fortification elk herd was initiated by the WGFD, in cooperation with the BLM and area landowners, with the collaring of 17 cows. Data from this study allowed the WGFD to better delineate crucial elk winter range, elk summer/yearlong range, and elk parturition range (USDI BLM 2006).

The WGFD defined two types of important elk habitats within the greater Fortification Creek area that are located within the elk yearlong range; crucial winter range and parturition (calving) range (Figure 3.3). Both provide important seasonal habitat functions during sensitive periods for elk. These crucial ranges overlap on the landscape and the overlapping area is referred to as "dual crucial" range. In March 2011, the BLM released a comprehensive Fortification Creek Planning Area RMPA/EA. Habitat for the Fortification elk herd is described in detail in this document. Table 3.6 summarizes elk habitat within the KDUE 2 project area.

Habitat effectiveness is the degree to which habitat features fulfill specific functions; (i.e., the degree to which a species or population is able use their habitat).

A security area is defined as "any area that will hold elk during periods of stress because of geography, topography, vegetation, or a combination of those features" (Lyon and Christensen 1992). Hillis et al. (1991) quantified security areas as nonlinear blocks of hiding cover ≥250 acres in size and ≥0.5 mile from any open road (Lyon and Canfield 1991, Hillis et al. 1991). WGFD also uses this definition (WGFD 2004). Security habitat is a subset of effective habitat. Descriptions of these habitats and the methods used to identify them are included in the FCPA RMPA, pp. 3-30 to 3-32, 4-39 to 4-77, and Appendix B.

Effective habitat is considered as all areas within the elk yearlong and crucial ranges that are 0.5 miles from roads or less than 0.5 miles where visibility of the road is obscured by topography. It was assumed that by calculating the loss of effective habitat around roads, the loss of effective habitat around wells would be accommodated. Security habitat was modeled as a contiguous block of effective habitat of 250 or more acres. Two hundred and fifty acres is a common minimum security patch size that has been used in other studies (Christensen et al. 1991, Leege 1984). The model did not account for vegetation.

The KDUE2 project partially falls within the Southwest Development Phase (SWDP) (24,850 acres) of the FCPA which is described in the FCPA-RMPA. Approximately 15,373 acres (62%) within the SW Phase was modeled as elk security habitat. Since the August 5, 2011 decision record on the FCPA-RMPA, no Federal oil and gas projects have been processed within the SWDP. The KDUE2 project includes 0.45 miles of proposed access road but no CBNG wells within elk security habitat of the SW Phase. The proposed access road provides the only reasonable access route to 10 proposed CBNG well locations on the west end of the KDUE2 project area. See Figure 3.4 below.

Table 3.7 Acres of Elk Ranges/Habitats within the KDUE 2 POD

Range/Habitat	Size (Acres)	Percent Area of the KDUE 2 Project Area [1]
Yearlong	1,840	100
Crucial Winter	1,637	89
Parturition	1,586	86
Effective Habitat	1,566	85
Security Habitat	1,512	82

1 Habitats may overlap and do not include all portions of the KDUE 2 Project area. Therefore, totals do not reflect all portions of the proposed project.

Figure 3.3 Affected Environment - Fortification Elk Herd Ranges

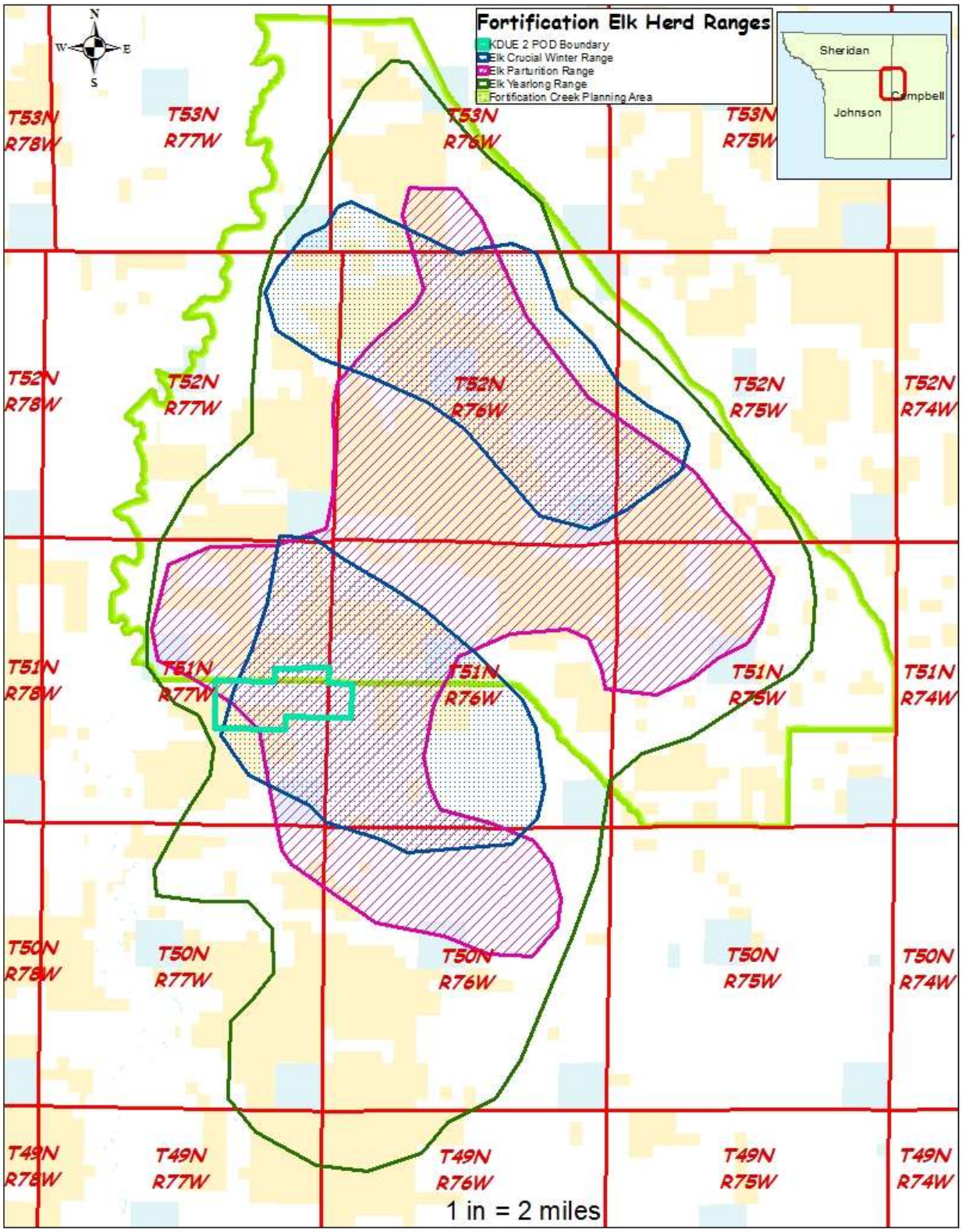


Figure 3.4 Kinney Divide Unit Epsilon 2 Project Area.

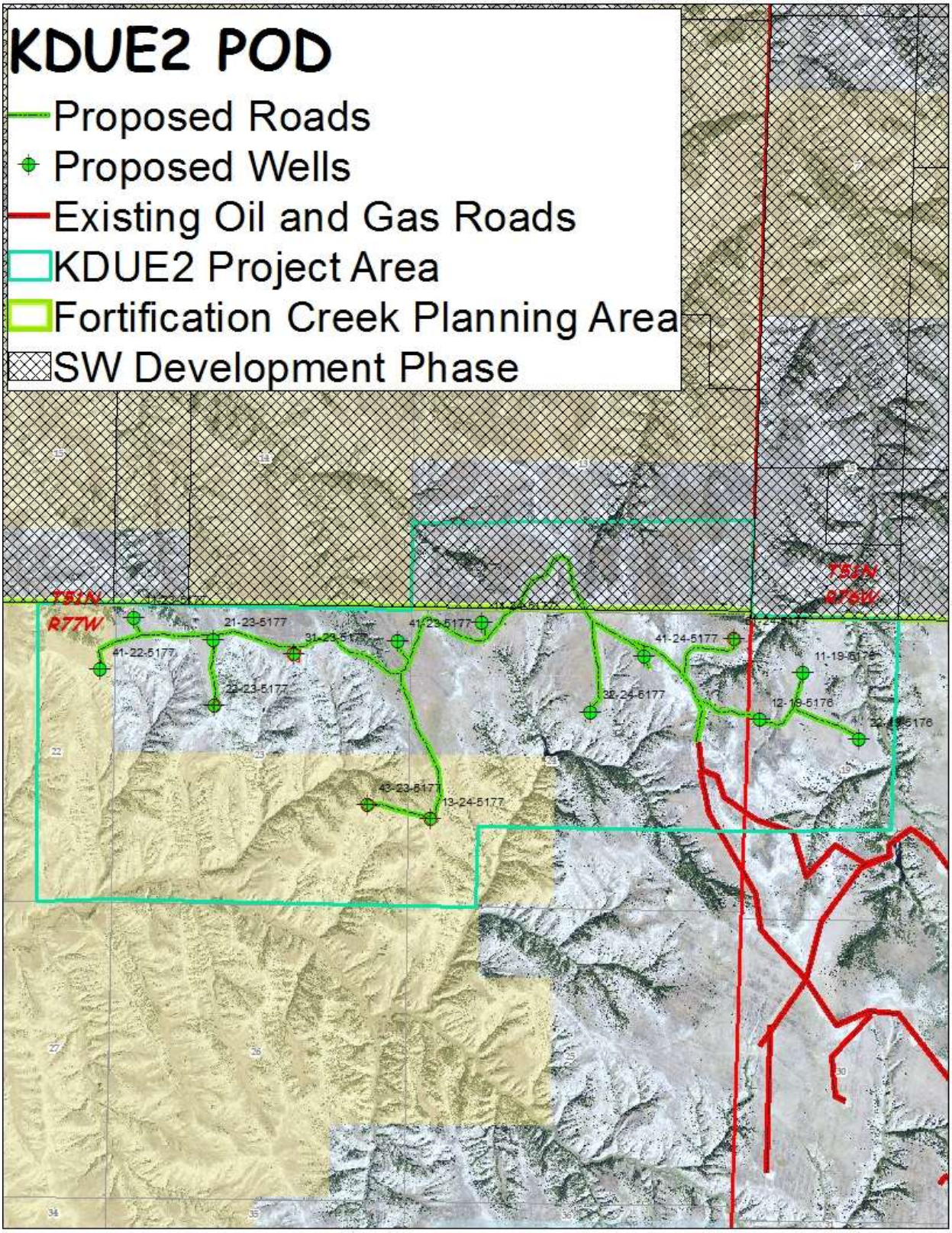
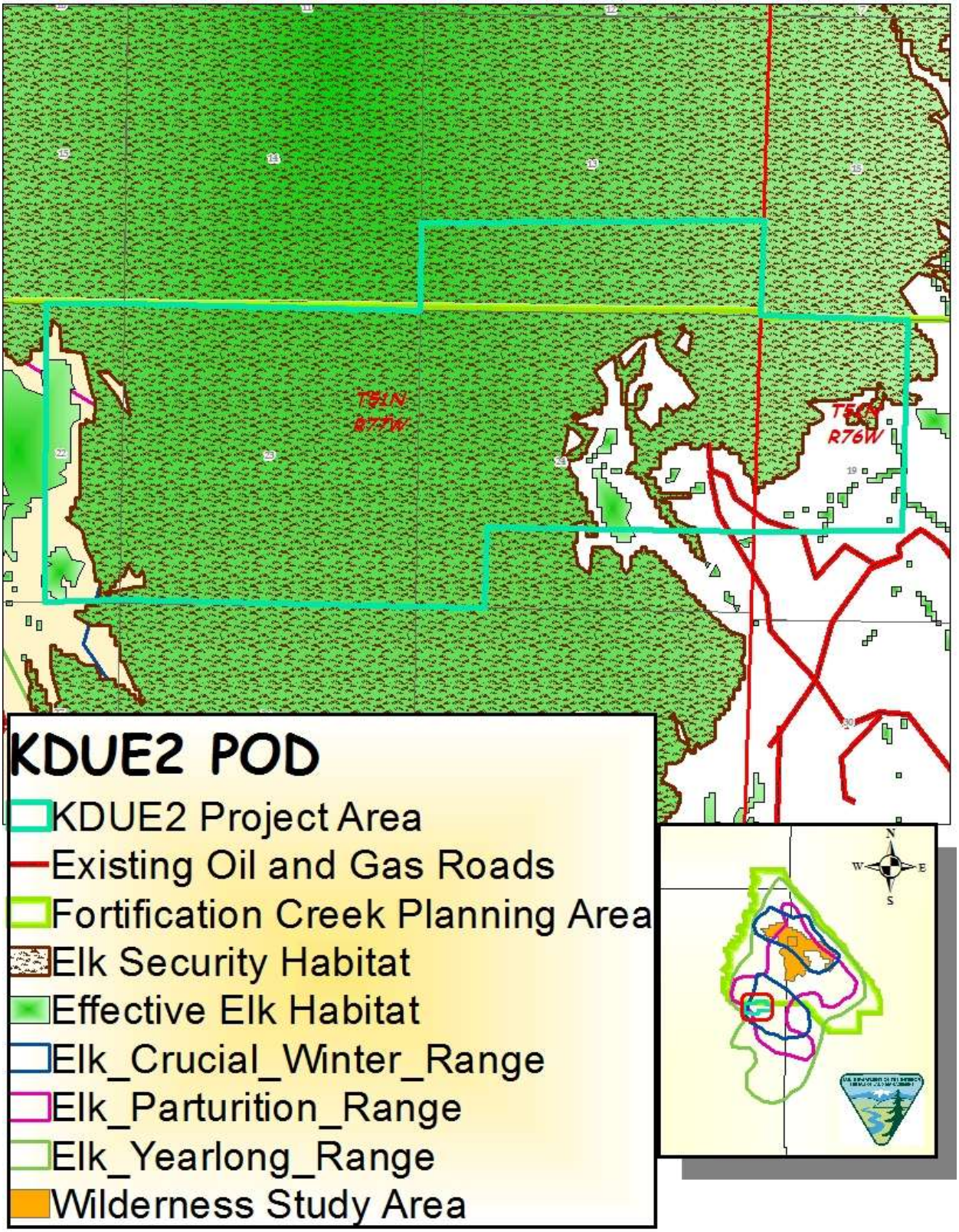


Figure 3.5 Elk Security Habitat and Effective Elk Habitat



The FCPA RMPA established performance standards for CBNG development. The performance standards will be used to achieve BLM goals and objectives for the FCPA. The goal is to maintain a viable elk herd across the FCPA utilizing their seasonal ranges during the appropriate seasons. To date, all 7 elk performance standards have been meet however only 10 of 103 Federal wells approved have been constructed and drilled. The current status of the 7 elk performance standards can be found in the Fortification Creek Planning Area Annual Monitoring Report, pages 2-10; See the web at: http://www.blm.gov/style/medialib/blm/wy/information/NEPA/bfodocs/fortification_creek.Par.13008.File.dat/FCPA-MonitRpt2013.pdf

The WGFD 2011 Job Completion Report (JCR) provides a 2011 post-season population estimate for the Fortification elk herd of 256. The 2012 post-season estimate was 511 (WGFD 2013). The WGFD changed population models in 2012; while the population likely increased in 2012 it is unlikely that the population doubled. The WGFD is trying to reduce the population through harvest which is estimated at 555 following the 2013 hunting season.

3.8.2.2.1. Habitat Use

Studies of elk radio telemetry from the early 1990s showed elk ranging out of the Fortification Creek area as far north as Montana. Recent studies of elk radio telemetry have shown that between 15 and 20% of the collared animals were observed, at least seasonally, outside the FCPA including; east of Wild Horse Creek, on the west side of the Powder River, south along the Kinney Divide, and occasionally as far north as Sonnette, Montana. Despite these movements, the elk yearlong range in the Fortification Creek Planning Area remains the core use area for the vast majority of this herd.

In April 2005, 26 elk (5 yearling bulls and 21 adult cows) from the Fortification elk herd were fitted with VHF radio collars. One cow was fitted with a GPS collar that could be manually tracked with a VHF receiver and via satellite. Radio-telemetry (VHF) and GPS collaring data collected by BLM and WGFD since 2005 have shown that the Fortification elk tend to avoid oil and gas development by moving to less developed areas. Some studies have shown that elk returned to the area of disturbance once the source of disturbance and human presence was gone (Gussey 1986, WGFD 2000), albeit at 50% or less of the previous levels in forested environments (Hayden-Wing Associates 1990). Sawyer et al. (2005) observed a similar response of elk within the more open terrain of the Jack Morrow Hills of Wyoming. The literature consistently shows a correlation between elk avoidance response and the level of human activity associated with roads, including those servicing oil and gas development. Radio-collared elk avoided available habitat that was within 1.7 miles of well sites and within 0.5 mile of roads (USDI BLM 2011a).

Monitoring the movement patterns of the Fortification elk continued with deployment of 38 additional VHF/GPS collars in March 2008 and 17 additional collars in December 2008. This effort was repeated in March 2011 and again January 2014 as the battery life of the VHF/GPS collars expires. Each time, 35 new VHF/GPS collars were deployed on cow elk. Data collected in 2008-2014 have shown similar trends as previously discussed.

As of January 1, 2015, over 280,000 relocation data have been recorded over the 81 months (March 2008 through December 2014) of monitoring with the GPS collars. Fifty-two (115) of the GPS collars deployed have recorded 7,335 observations (2.6% of all observations) within the KDUE2 project boundary. This project area has the highest density of elk relocations observed from CBNG projects previously analyzed within the FCPA. Lower incidence of use was observed in previously analyzed CBNG projects (i.e.;CJU-SMA1.2, 2.2%; CJU-SMA1.1, 0.45%; Queen B, 0.07%; Elsie, 0.05%).

Collared elk consistently used the project area during the 2008 through 2014 calving seasons (May 15

through June 15). Twenty-one individual collared elk were relocated a total of 348 within the project are during the calving season.

Fresh elk sign (tracks and droppings) were observed during every field visit. During field visits, elk sign was observed throughout the project area with the highest use observed late fall to early spring. Individuals were observed on occasion as they fled into thick juniper cover or over ridge tops.

3.9. Migratory Birds

The PRB FEIS discussed the affected environment for migratory birds, pp. 3-150 to 3-153. Migratory birds migrate for breeding and foraging at some point in the year. The BLM-FWS MOU (2010) promotes the conservation of migratory birds, as directed through Executive Order 13186 (Federal Register V. 66, No. 11). BLM must include migratory birds in every NEPA analysis of actions having potential to affect migratory bird species of concern to fulfill obligations under the Migratory Bird Treaty Act (MBTA). BLM encourages voluntary design features and conservation measures agreeing with those in the programmatic mitigation in Appendix A of the PRB ROD.

Habitats types include sagebrush steppe grasslands and mixed grass prairie. Many species that are of high management concern use these areas for their primary breeding habitats (Saab and Rich 1997). Nationally, grassland and shrubland birds declined more consistently than any other ecological association of birds over the last 30 years (WGFD 2009). The FWS's Birds of Conservation Concern (BCC 2008) report identifies species of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act. Species in this list that have the potential to occur in the project area are: Brewer's sparrow, sage thrasher, loggerhead shrike, short-eared owl, and grasshopper sparrow. Of these, 3 species are identified on the BLM Wyoming Sensitive Species list. More information about the BCC is on the Wyoming Ecological Services website.

The WGFD Wyoming Bird Conservation Plan (Nicholoff 2003) identified 3 groups of Wyoming's high-priority bird species: Level I – those that clearly need conservation action, Level II – species where the focus should be on monitoring, rather than active conservation, and Level III – species that are not of high priority but are of local interest. Species likely occurring in the project area are identified in Table 3.7.

Table 3.8 Migratory Bird Species Occurring in Shrub-Steppe Habitat, NE Wyoming (Nicholoff 2003)

Level	Species	Wyoming BLM Sensitive
Level I	Brewer's sparrow	Yes
	Ferruginous hawk	Yes
	Greater Sage-Grouse	Yes
	McCown's longspur	No
	Sage sparrow	Yes
Level II	Lark bunting	No
	Lark sparrow	No
	Loggerhead shrike	Yes
	Sage thrasher	Yes
	Vesper sparrow	No
Level III	Common poorwill	No
	Say's phoebe	No

3.10. Raptors

The affected environment for raptors is discussed in the PRB FEIS on pp. 3-141 to 3-148. BHEC completed aerial and ground surveys for raptor and bald eagle nesting within the project area beginning in 2008 through 2014. Surveys were conducted within 1 mile of the project area for bald eagle nests and within 0.5 mile of the project area for all other raptor species. According to the BHEC 2014 wildlife surveys and the BLM database, 13 raptor nests are found within 0.5 mile of the project area. Three nests, 2 red-tailed hawk and 1 great horned owl, were active in 2014. No bald eagle nests were found in the area.

3.11. Upland Game Birds (Plains Sharp-tailed Grouse)

The affected environment for plains sharp-tailed grouse is discussed in the PRB FEIS, pp. 3-148 to 3-150. Plains sharp-tailed grouse are discussed in this document because specific concerns for this species were identified during the scoping process for the PRB FEIS. The affected environment for plains sharp-tailed grouse is discussed in the PRB FEIS on pp. 3-148 to 3-150.

Surveys for grouse species were conducted using WGFD and BLM protocols that required surveys extend 0.64 mile beyond the proposed project boundary. Ground surveys were conducted for grouse species during spring 2014 (BHEC 2014). Habitats within the KDUE2 project area have the potential to support sharp-tailed grouse throughout the year. The nearest known sharp-tailed grouse lek is 2.4 miles south located NWNW, Section 1, T50N R77W.

3.12. Threatened, Endangered, Candidate and Special Status (Sensitive) Species (SSS)

Threatened, Endangered, and Candidate species that could be affected beyond the level analyzed within the PRB FEIS are described below. At this time, there are no proposed species known to be present within the BFO resource area.

The Buffalo BLM received a species list on July 22, 2011 from the US Fish and Wildlife Service concerning Threatened, Endangered and Candidate species. The July 2011 list included Ute Ladies'-tresses orchid (Threatened) and Greater Sage-grouse (Candidate). The Northern long-eared bat (*Myotis septentrionalis*) was proposed for listing under the ESA by the USFWS in October 2013 (October 2, 2013; 78 FR 61046).

3.12.1. Threatened and Endangered Species

3.12.1.1.1. Ute Ladies'-tresses Orchid

The Ute ladies'-tresses orchid (ULT) is listed as threatened under the ESA. The affected environment for ULT is discussed in the PRB FEIS on p. 3-175.

The proposed well locations and infrastructure are proposed in dry upland vegetation without a source of perennial water. The POD does not contain historically perennial sources of water to support habitat for ULT (BHEC 2014). The ephemeral drainages have heavy clay soils and immediately rise to upland vegetation, reducing potential for this species.

3.12.1.2. Northern long-eared bat

The northern long-eared bat ranges across much of the eastern and north central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (USFWS 2013c). The species is known to occur in northeastern Wyoming and has been documented in Campbell, Crook, and Weston counties; however, population information is limited and the species is considered uncommon or rare outside of the Black Hills in Wyoming (USFWS 2013c). No surveys for the species have been conducted in the project area but the species is not suspected to in the KDUE2 area.

3.12.2. Greater Sage-Grouse(GSG)

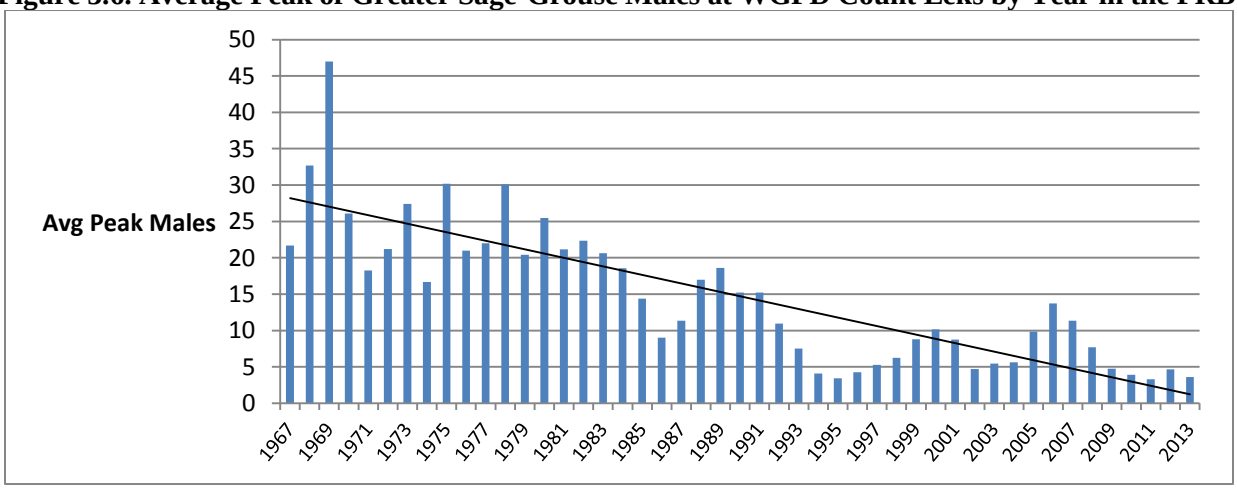
The PRB FEIS has a detailed discussion on GSG ecology and habitat, pp. 3-194 to 3-199. Subsequently the FWS determined the GSG warrants federal listing as threatened across its range, but precluded listing due to other higher priority listing actions, 75 Fed. Reg. 13910 to 14014, Mar. 23, 2010; 75 Fed. Reg. 69222 to 69294, Nov. 10, 2010. GSG are a WY BLM special status (sensitive) species (SSS) and a WGFD species of greatest conservation need because of population decline and ongoing habitat loss. The 2012 population viability analysis for the Northeast Wyoming GSG found there remains a viable population of GSG in the PRB (Taylor et al. 2012). However, threats from energy development and West Nile virus (WNv) are impacting future viability (Taylor et al. 2012). The BLM IM WY-2012-019 establishes interim management policies for proposed activities on BLM-administered lands, including federal mineral estate, until RMP updates are complete.

Impacts to GSG from energy development are documented at various scales. The State Wildlife Agencies' Ad Hoc Committee for Consideration of Oil and Gas Development Effects to Nesting Habitat (2008) implicates that impacts to leks occur within 4 miles of oil and gas developments, and recommends development at a scale of one well per square mile. In its *Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats* (2009), WGFD categorized impacts to GSG by number of well pad locations per square mile within 2 miles of a lek and within identified nesting/brood-rearing habitats greater than 2 miles from a lek. The State Wildlife Agencies' Ad Hoc Committee for Consideration of Oil and Gas Development Effects to Nesting Habitat (2008) implicates that impacts to leks occur within 4 miles of oil and gas developments. Impacts from oil and gas development are discernible at the spatial scale of 20 km (12.4 mi) (Taylor et al. 2012). WGFD records show that no GSG leks occur within 4 miles of the project area. The GSG population in northeast Wyoming is exhibiting a steady long term downward trend, as measured by lek attendance (WGFD 2013b). Figure 3.1 illustrates a 10-year cycle of periodic highs and lows. Each subsequent population peak is lower than the previous peak. Research suggests that the declines since 2001 are a result, in part, of energy development (USFWS 2010, Taylor et. al. 2012).

Site Specific Habitat

The project area is not within a core population area, as identified in EO 2011-5. GSG habitat models show that the project area contains high quality GSG nesting and winter habitat (Walker et al. 2007) that may serve as connectivity habitat between GSG leks east and west of the project area. Surveys for GSG found suitable sage brush habitat exists throughout the project area to support the sage brush obligate species (BHEC 2014). BLM confirmed sagebrush shrublands provide suitable nesting, brood rearing, and winter habitat in the project area; however, there are no known leks within 4 miles of the proposed infrastructure.

Figure 3.6. Average Peak of Greater Sage-Grouse Males at WGFD Count Leks by Year in the PRB



3.13. BLM Sensitive Species

The PRB FEIS discussed the affected environment for SSS, p. 3-174 to 201. The authority for the SSS comes from the ESA, as amended; Title II of the Sikes Act, as amended; the FLPMA; Department Manual 235.1.1A and BLM Manual 6840. The sensitive species that may occur in the project area are listed in the FCPA-RMPA pp 3-33 and 3-14. The Table also includes a brief description of the habitat requirements for each species. Wyoming BLM annually updates its list of sensitive species to focus management to maintain habitats to preclude listing as a threatened or endangered species. The policy goals are:

- Maintaining vulnerable species and habitat components in functional BLM ecosystems;
- Ensuring sensitive species are considered in land management decisions;
- Preventing a need for species listing under the Endangered Species Act (ESA); and
- Prioritizing needed conservation work with an emphasis on habitat.

Wyoming BLM updates sensitive species on its website:
http://www.blm.gov/wy/st/en/programs/Wildlife.html.
BLM discusses those sensitive species impacted beyond the level analyzed in the PRB FEIS, below.

3.13.1.1. Bald Eagle

The affected environment for bald eagles is described in the PRB FEIS on p. 3-175. At the time the PRB FEIS was written, the bald eagle was listed as a threatened species under the ESA. It was removed from the ESA on August 8, 2007. The bald eagle remains under the protection of the Bald and Golden Eagle Protection Act and the MBTA.

Suitable nesting and winter roosting habitat in the vicinity of the proposed project is limited to mature cottonwood trees along Powder River, and scattered mature ponderosa pines in upland areas. Aerial and ground surveys were conducted within 1 mile of the project area for bald eagle nest and winter roost sites. Nest surveys were conducted in spring 2014, and winter roost surveys were conducted during winter 2008 – 2013 (BHEC 2014). The KDUE2 POD was included in aerial surveys for wintering bald eagles on December 18, 2013 and January 28, 2014. No bald eagles were observed perched within 1 mile of the POD and no bald eagle nests were identified (BHEC 2014).

3.13.1.2. Ferruginous Hawk

The affected environment for ferruginous hawk is discussed in the PRB FEIS on p. 3-183. This species is found within grasslands, agricultural lands, sagebrush/saltbrush/greasewood, shrublands, and the periphery of juniper woodlands. Suitable foraging habitat for the ferruginous hawk is present throughout the POD. However, no active ferruginous hawk nests were identified during past raptor nest surveys (see Table 3.11).

3.13.1.3. Fringed Myotis

The affected environment for fringed myotis is discussed in the PRB FEIS on pp. 3-188 to 3-189. The fringed myotis is most commonly found in xeric woodlands, such as juniper, ponderosa pine, and Douglas fir. It typically forages over water, along forest edges, or within forests and woodlands. Roost sites and hibernacula include rock crevices, tree cavities, caves, abandoned mines, and buildings (WGFD 2005). Suitable habitat for the fringed myotis is present throughout the POD. There have not been any bat surveys within the project area.

3.13.1.4. Long-eared Myotis

The affected environment for long-eared myotis is discussed in the PRB FEIS on pp. 3-201. In addition to being listed as a Wyoming BLM-Sensitive Species, the long-eared myotis is a WGFD SGCN, with a rating of NSS2, because populations are restricted in distribution, they are experiencing ongoing

substantial loss of habitat, and they are sensitive to human disturbance.

The long-eared myotis primarily inhabits coniferous forest and woodland, including juniper, ponderosa pine, and spruce-fir. It typically forages over rivers, streams, and ponds within the forest-woodland environment (WGFD 2005). Roost sites include a wide variety of structures, including cavities in snags, under loose bark, stumps, buildings, rock crevices, caves, and abandoned mines (WGFD 2005). During winter, it hibernates in caves and abandoned mines (WGFD 2005). Suitable habitat for the fringed myotis is present within the POD area. There have not been any bat surveys within the project area.

3.14. Aquatics

The PRB ecosystem and fishery is discussed in the PRB FEIS (pp. 3-153 to 3-166). The project area is in the Barber Creek watershed which is a tributary to the Upper Powder River.

Table 3.7 lists the fish found in the Upper Powder River sub-basin and their WGFD NSS designation. Seven of the species that may occur in the Upper Powder River sub-basin have designations as either NSS 1, 2, or 3 species. Species in these designations are species of concern, in need of more immediate management attention, and more likely subject to future petitioning under the ESA. For these species WGFD recommends that no loss of habitat function occur.

Table 3.9 Fish Occurring in the Upper Powder River Sub-basin

Wyoming Native Species Status	Species	Wyoming BLM Sensitive
NSS1	Sturgeon chub	No
NSS2	Goldeye	No
	Sauger	No
NSS3	Black bullhead	No
	Flathead chub	No
	Mountain sucker	No
	Plains minnow	No
NSS4	Channel catfish	No
	Northern redhorse	No
	Quillback	No
	River carpsucker	No
	Stonecat	No
NSS6	Fathead minnow	No
	Plains killifish	No
NSS7	Longnose dace	No
	Sand shiner	No
	White sucker	No
None	Common carp	No
	Rock bass	No
	Shovelnose sturgeon	No

3.15. West Nile Virus

West Nile virus (WNv) is a mosquito-borne disease that can cause encephalitis or brain infection. Mosquitoes spread this virus after they feed on infected birds and then bite people, other birds, and animals. WNv is not spread by person-to-person contact, and there is no evidence that people can get the virus by handling infected animals.

Since its discovery in 1999 in New York, WNv has become established and spread across the United States. Birds are the natural vector host and serve not only to amplify the virus, but to spread it. *Culex tarsalis* appears to be the most common mosquito vector. Mosquitoes can hatch from standing water in as few as four days.

Data collected by the CDC and published by the USGS at www.westnilemaps.usgs.gov are summarized in Table 3.14. Reported data from the Powder River Basin (PRB) includes Campbell, Sheridan and Johnson counties.

Table 3.10 Historical West Nile Virus Information

Year	Total WY Human Cases	Human Cases PRB	Equine Cases PRB	Bird Cases PRB
2001	0	0	0	0
2002	2	0	15	3
2003	392	85	46	25
2004	10	3	3	5
2005	12	4	6	3
2006	65	0	2	2
2007	155	22	Unknown	1
2008	10	0	0	0
2009	10	1	1	No record
2010	6	0	0	0
2011	3	0	Unknown	No record
2012	7	0	1	0
2013	41	4	10	2

Source: Wyoming Department of Health, http://diseasemaps.usgs.gov/wnv_wy_human.html

Human cases of WNv in Wyoming occur primarily in the late summer or early fall. WNv has been detected in 157 bird species, horses, 16 other mammals, and alligators (Marra et al 2003). In the eastern US, avian populations have incurred very high mortality, particularly corvids (crows, jays). Raptor species also appear to be highly susceptible to WNv. During 2003, 36 raptors were documented to have died from WNv in Wyoming including golden eagle, red-tailed hawk, ferruginous hawk, American kestrel, Cooper's hawk, northern goshawk, great-horned owl, prairie falcon, and Swainson's hawk (Cornish et al. 2003).

The Wyoming State Vet Lab determined 22 Greater Sage-Grouse in one study (90% of the study birds), succumbed to WNv in the PRB in 2003. While birds infected with WNv have many of the same symptoms as infected humans, they appear to be more sensitive to the virus (Rinkes 2003). Current science suggests a synergy between West Nile virus and energy development that amplifies the negative impact Greater Sage-Grouse (USFWS 2010 p. 13947).

In the PRB, there is increased surface water associated with CBNG development. This increase in potential mosquito breeding habitat provides opportunities for mosquito populations to increase. Preliminary research conducted in the PRB indicates WNv mosquito vectors were notably more abundant on a developed CBNG site than two similar undeveloped sites (Walker et al. 2003).

The WDEQ and the Wyoming Department of Health sent a letter to CBNG operators on June 30, 2004. The letter encouraged people employed in occupations that require extended periods of outdoor labor, be provided educational material by their employers about WNv to reduce the risk of WNv transmission.

3.16. Cultural Resources

In accordance with section 106 of the National Historic Preservation Act, BLM must consider impacts to historic properties (sites that are eligible for or listed on the National Register of Historic Places (NRHP)). For an overview of cultural resources that are generally found within BFO the reader is referred to the Draft Cultural Class I Regional Overview, Buffalo Field Office (BLM, 2010). A Class III (intensive) cultural resource inventory (BFO project no. 70140083) was performed in order to locate specific historic properties which may be impacted by the proposed project. The following resources are located in or near the proposed project area.

Table 3.11 Cultural Resource Sites In or Near the KDUE 2 POD

Site Number	Site Type	Eligibility
48JO4264	Historic	Not Eligible
48JO4266	Historic	Not Eligible

3.17. Recreation

As stated in the 1985 Buffalo Resource Management Plan, "The Powder River Breaks are nationally known for big game hunting. Hunters come to the area from throughout the continental United States". Hunting use has been increasing during the last seven years. Lands within the POD include portions of elk hunt area 2, antelope hunt area 17, and deer hunt area 17.

The WGFD's 2011 Annual Report shows the economic return per animal (that would be harvested elk) was set at $1,678. According to the 2011 Annual Report of big and trophy game harvest there were 47 elk harvested in 2010 from the Fortification herd unit; i.e. 47 elk harvested X $1,678 = $78,866. In recent years, elk harvest has averaged around 50 elk which would be a recreational value of $75,000 to $80,000 per year.

The KDUE2 POD contains approximately 610 acres of BLM administered surface. Public lands consist of isolated tracts that lack either the size or the public access needed to provide a quality recreation experience. Recreationists may acquire permission from the adjacent landowners to access other federal lands. Traditionally, this practice involves the payment of a fee to the private landowner for access to the BLM land, and is usually associated with hunting.

4. ENVIRONMENTAL EFFECTS

This section describes the environmental effects of the No Action Alternative (Alternative A) and the Proposed Action (Alternative B). The effects analysis addresses direct, indirect, and cumulative effects; identifies and analyzes mitigation measures; and discloses any residual effects remaining following mitigation.

Design changes to the original proposal mitigated some impacts that would result from adopting the proposed project. Alternative B analyzes the environmental effects remaining following these design changes.

Alternative A

The No Action Alternative was analyzed as Alternative 3 in the PRB FEIS, and is incorporated by reference into this EA. Information specific to resources for this alternative is included within the PRB FEIS on pp. listed in Table 4.1.

Table 4.1 Location of Discussion of the No Action Alternative in the PRB FEIS

Resource		Type of Effect	Page(s) of PRB FEIS
Project Area Description	Geologic Features and Mineral Resources	Direct and Indirect Effects	4-164 and 4-134
		Cumulative Effects	4-164 and 4-134
Soils, Vegetation, and Ecological Sites	Soils	Direct and Indirect Effects	4-150
		Cumulative Effects	4-152
	Vegetation	Direct and Indirect Effects	4-163
		Cumulative Effects	4-164
	Wetlands/Riparian	Direct and Indirect Effects	4-178
		Cumulative Effects	4-178
Wildlife	Sensitive Species - Greater Sage-Grouse	Direct and Indirect Effects	4-271
		Cumulative Effects	4-271
	Aquatic Species	Direct and Indirect Effects	4-246
		Cumulative Effects	4-249
	Migratory Birds	Direct and Indirect Effects	4-234
		Cumulative Effects	4-235
	Big Game	Direct and Indirect Effects	4-186
		Cumulative Effects	4-211
	Raptors	Direct and Indirect Effects	4-224
		Cumulative Effects	4-225
Water	Groundwater	Direct and Indirect Effects	4-63
		Cumulative Effects	4-69
	Surface Water	Direct and Indirect Effects	4-77
		Cumulative Effects	4-69
Cultural Resources		Direct and Indirect Effects	4-273
		Cumulative Effects	4-287
Transportation, Visual Resources, Recreation and Economics	Transportation	Direct and Indirect Effects	4-298
		Cumulative Effects	4-302
	Visual Resources	Direct and Indirect Effects	4-302
		Cumulative Effects	4-314
	Recreation	Direct and Indirect Effects	4-319
		Cumulative Effects	4-328
	Economics	Direct and Indirect Effects	4-336
		Cumulative Effects	4-364

Alternative B

4.1. Project Area Land Uses

4.1.1. Direct and Indirect Effects

Short-term direct effects (2 years or less) will exist for land uses within and adjacent to the project area due to construction activities, including surface disturbance, dust generation, and noise associated with heavy equipment operation. Construction, initial operation, and well servicing and maintenance would likely displace wildlife. Consequently, this would reduce the success of big game hunting in the area. Likewise, livestock grazing opportunity would be reduced impacting the success of stock growers' operations. These effects would continue until drilling and construction activities are complete, interim

reclamation and stabilization measures achieve a steady state, and well visitation and generator refueling are minimized.

Interim reclamation is proposed to revegetate portions of the well pads, and access roads no longer needed after construction. Project impacts that will be long term (greater than 2 years) result from the use of pads and roads needed for operations and maintenance for the life of the project (approximately 10-20 years). It is anticipated that these lands would not be available for wildlife or livestock grazing or other land uses during that time frame.

4.1.2. Cumulative Effects

Cumulative effects to land uses from oil and gas development are discussed in the PRB FEIS in page 4-298 and in the RMP Amendment on pages 4-107 to 4-129.

4.1.3. Mitigation Measures

No additional mitigation is proposed for the effects to land use. However, in conformance with the FCPA RMPA, the proposed project design minimizes surface disturbance by maximizing the use of current infrastructure, minimizing well pad sites and impoundments as appropriate therefore lessening adverse effects to current land use.

4.1.4. Residual Effects

Land use at the wells and along the roads and utility corridors would be converted for the duration of the well operation (and until final reclamation is achieved) to a mineral development use. During this timeframe, the proposed lands would offer marginal if any grazing potential.

4.2. Air Quality

In the project area, air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing, as well as drilling rig and vehicle engine exhaust) and production (including well production equipment, booster and pipeline compression engine exhaust). The operator will control the amount of air pollutant emissions during construction by watering disturbed soils, and by air pollutant emission limitations imposed by applicable air quality regulatory agencies. Air quality impacts modeled in the PRB FEIS and Cumulative Air Quality Effects, 2009 concluded that PRB projected fluid and solid development would not violate state, tribal, or federal air quality standards and this project is well within the projected development parameters.

4.3. Transportation

4.3.1. Direct and Indirect Effects

The PRB FEIS discussed direct and indirect effects to transportation on pp. 4-298 to 4-302. BLM analyzed transportation associated with CBNG development in the CJU SMA 1.2 POD EA, WY-070-EA12-084, pp. 51-52, incorporated here by reference. Effects and mitigation associated with this project are similar in nature, with the following additional site-specific information.

The main access to the POD is off of Campbell County's Montgomery Road to oil and gas lease roads through the Carr Draw and Augusta CBNG Units to the southeast corner of the project area in Section 24, T51N/R77W. The KDUE2 plan of development proposes 5.6 miles of new inslope, outslope and crown and ditch resource roads. There are 9 engineered sections provided by Kadrmas Lee & Jackson, Inc. (KLJ) with an average travel way surface of 16 feet. The lowest design speed for the POD is 10 mph with an average daily traffic (ADT) ranging from 1 to 20 trips per day. The in-sloped and out-sloped roads have road grades less than 8%, and the crown and ditch roads have grades less than 16%. The maximum road grade proposed is less than 16%. There are an additional 22 proposed culverts that have a minimum diameter of 18 inches and additional cross drain culverts will be added as needed during construction. Culvert installation will follow the typical installation details provided in the engineered diagrams.

Additional culverts and wing ditches may be needed through the life of the project and will be addressed via the sundry process.

Transportation use of the roads would be converted for the duration of the well operation to a mineral development use, 10-20 years. During this timeframe, the road network would experience all weather use with an Average Daily Traffic (ADT) of 2-20 vehicles. This is far in excess of seasonal fair-weather use of primitive roads used for livestock operations and recreational use. If roads are constructed as proposed, stabilized, and well maintained the residual effects associated with road traffic use should be minimal. Roads that remain in place after well abandonment are subject to deteriorate over time without regular maintenance and contribute to accelerated erosion. Since there is no public access to the area, roads on BLM surface would be reduced to their original primitive state or reclaimed completely.

4.3.2. Mitigation

All constructed road segments will be completed, including any culverts, low water crossings and required surfacing, before the drilling rig or other drilling equipment moves onto a well pad.

The BLM requires the following road conditions on federal surface to be surfaced with an average of 4 inches of Gradation "W" as outlined in the WY Highway Department specifications for road and bridge construction per the BLM Manual Supplement WYSO for 9113:

- All roads with grades steeper than 8% grade
- All roads with an anticipated ADT of 10 or greater
- All engineered road segments

The operator is responsible for having the licensed professional engineer(s) certify that the actual construction of the road meets the design criteria and is constructed to Bureau standards.

BLM will apply a COA that requires the operator to provide for construction oversight of all engineered roads and well pads.

4.4. Soils

4.4.1. Direct and Indirect Effects

The impacts listed below would result in increased: soil loss due to increased water and wind erosion; invasive plant establishment; and increased sedimentation and salt loads to the watershed. Soil productivity would decrease, primarily as a result of profile mixing and compaction along with the loss in vegetative cover.

Impacts anticipated to occur include soil rutting and mixing, compaction, increased erosion potential, and loss of soil productivity. Most impacts would occur with the construction of 10 well pads, pipelines and roads. These impacts begin with the grading and leveling required to construct these features. The greatest effort is required on areas with steep slopes. During construction, the soil profile would be mixed with a corresponding loss of soil structure. Mixing may result in removal, dilution, or relocation of organic matter and nutrients to depths where it would be unavailable for vegetative use. Less desirable inorganic compounds such as carbonates, salts, or weathered materials could be relocated and have a negative impact on revegetation.

Minimal construction will be needed at 6 of the 16 wells with no well pad needed resulting in less soil disturbance to the soil resource. These locations have less than 4 percent side slope requiring no soil to be removed or graded to level the work space. Surface disturbance at these locations would be limited to no grading at 5 sites and less than 2 feet of leveling at 1 site, the excavation of the 2 reserve pits (36ft by 16ft by 12ft deep each) and installation of buried gas and water pipelines and a combination of buried and

overhead electrical power lines. Where reserve pits are excavated for these wells, soil productivity and soil quality would be negatively altered when subsoil is spread on the surface of the soil.

Soil rutting affects the surface hydrology as well as the rooting environment. The process of rutting physically severs roots and reduces the aeration and infiltration of the soil, thereby degrading the rooting environment. Rutting may result in mixing of topsoil and subsoil, thereby reducing soil productivity. Rutting also disrupts natural surface water hydrology by diverting and concentrating water flows creating accelerated erosion. Soil mixing typically results in a decrease in soil fertility and a disruption of soil structure.

A decrease in soil productivity also would occur in association with soil salvage and stockpiling activities as microbial action is reduced in long-term stockpiles. These impacts would begin immediately as the soils are subjected to grading and construction activities and impacts would continue for the term of operations. The disturbed soils should be stabilized immediately but likely would not be fully stabilized until construction activities were completed and well production/maintenance operations begin.

Soils would be compacted as a result of the construction of well and associated facilities, with compaction continued from operational activities such as vehicle and foot traffic. Factors affecting compaction include soil texture, moisture, organic matter, clay content, pressure exerted, and the number of passes by vehicle traffic or machinery. Compaction leads to a loss of soil structure; decreased infiltration, permeability, and soil aeration; as well as increased runoff and erosion. Increased erosion can lead to a decrease in soil fertility and an increase in sedimentation. The duration and intensity of these impacts would vary according to the type of construction activity to be completed and the inherent characteristics of the soils to be impacted. During interim and final reclamation, cat walking steep slopes, a common practice, would further compact soils and increase runoff and erosion.

The potential for erosion would increase through the loss of vegetation cover and soil. A Storm Water Pollution Prevention permit (SWPPP) is required for construction activities and would address sediment control. Under the terms and conditions of the permit visible or measurable erosion is defined as:

- "Deposits of mud, dirt, sediment, or similar material exceeding one cubic foot volume in any area of 100 square feet or less on public or private roads, adjacent property, or into waters of the state by deliberate actions as a result of water or wind erosion; bare soils, turbid or sediment-laden flows, or evidence of on-site erosion on bare slopes, where runoff of water is not filtered, treated, or captured on the site using BMPs specified in the SWPPP; or
- Earth slides, mud flows, earth sloughing, or other earth movement which leaves the construction site."

Compliance with the term and conditions of the SWPPPs does not assure meeting the objectives of stabilization and interim reclamation of the BLM as minimal erosion is allowable. The BLM performance standards not only meet the SWPPP terms and conditions but the land use plan objectives for the FCPA-RMPA.

Culverts and wing ditches would be installed to control storm water runoff associated with road construction.

Additional effects to soils resulting from well pad, access roads, and utility corridor construction include:

- Loss of biologic crusts, organic matter, and productivity; and
- Increased soil erosion and reduced soil health and productivity. Erosion rates are site-specific and are dependent on soil, climate, topography, and cover.

Biological soil crusts are adapted to growing in severe climates; however, they take many years to develop (20 to 100 years) and can be easily damaged or destroyed by surface disturbances associated with construction activities. They are present throughout the project area, particularly in areas with shallow soils. The prevalence of biologic crust increases proportionately to the amount of bare ground in the absence of vascular plants. These crusts have not been well studied in the area, so their current extent or survival trend is unknown.

During initial site visits to the well sites, BLM staff observed site conditions for well pads and access roads. Some well sites were adjusted or moved to minimize siting on steep slopes, minimize soil erosion, and minimize facilities on soils with limited reclamation potential (LRP).

Many road and utility corridors are located on severely erodible soils as they persist throughout the project area. The new crowned & ditched road construction over 14,598 feet of flat bladed and bench cut roads that are failing to accommodate runoff and control erosion. Improving the existing roads will result in less disturbance and erosion than building new roads on new alignments. All utility corridors are with access road rather than cross country further reducing linear surface disturbance in the area.

Multiple resources are affected by the overall amount of disturbance introduced into the area. Keeping disturbance to a minimum is important for successful reclamation and to reduce negative impacts to these resources. Improved roads constructed properly will accommodate runoff and erosion control. However, these disturbances will increase disturbance acreage, loss of biologic crusts, organic matter, and soil productivity until vegetation is reestablished. Additionally, this will increase soil erosion and decrease soil health and productivity. The negative impacts to the multiple affected resources will be increased.

BKS Environmental Associates, Inc. (BKS) developed a reclamation plan for Anadarko's KDUE2 POD that identifies the various vegetation, soil(s), ecological site description(s), and provides recommended reclamation prescriptions. This reclamation plan includes site specific site evaluations for 4 of the 16 wells as well as 8 access roads with utility corridor listed below.

Table 4.2. Wells, Roads and Infrastructure with Site Specific Reclamation Plans

KDU Federal 43-23-5177 well pad	Engineered road #1 and utility corridor
KDU Federal 43-23-5177 road and utility corridor	Engineered road #3 and utility corridor
KDU Federal 41-23-5177 well pad	Engineered road #5 and utility corridor
KDU Federal 41-23-5177 road and utility corridor	Engineered road #6 and utility corridor
KDU Federal 13-24-5177 well pad	Engineered road #7 and utility corridor
KDU Federal 32-24-5177 well pad	Template Road #3 and utility corridor

In the *Reclamation Plan - Kinney Divide Unit Epsilon 2 POD (11/4-2014)* prepared by BKS, erosion control practices are identified. These practices are meant to prevent runoff and encourage successful reclamation. However, the mitigation measures identified in the report fail to address the very shallow soils and local areas of coal and shale outcrops identified in the report. Disturbance to these areas without proper erosion control practices will lead to accelerated soil erosion and decreased soil health and productivity.

The following are examples from the Anadarko reclamation plan:
The reclamation plan provides diagrams showing pads and roads and describes where and what reclamation practices will be applied. The plan calls for cut and fill slopes to be "pulled back" at the conclusion of drilling operations to approximate surrounding topography for the life of the wells. The pad diagrams show erosion control barriers above the cut slopes. Other erosion control measures include bio-degradable polymers, hydro-mulch, and erosion control blankets. The reclamation plans call for "velocity

controls" or slope breakers to be placed on cut and fill slopes. Manufacturer specifications detail the appropriated spacing of slope breakers needed to reduce slope length thereby minimizing erosion on steep slopes created by construction.

Areas that are difficult to reclaim include shallow clayey sites and areas where the parent material is very shallow (typically less than 10 inches deep). The plant communities on these areas can be difficult to re-establish, especially in areas where depth to parent material is shallow. These areas were identified during initial site visits. On-the-ground alternatives were limited but where alternatives were identified by BLM and Anadarko, the operator chose to implement most of them. In other cases, BLM applied COAs minimize impacts.

To ensure the engineered roads and well pads of the KDUE2 POD are constructed as designed, adequate construction oversight is necessary. This will prevent excessive disturbance and irrecoverable soil loss.

BLM requires the operator to follow the guidance provided in the Wyoming Policy on Reclamation (IM WY-90-231).The Wyoming Reclamation Policy applies to all surface disturbing-activities. Authorizations for surface-disturbing actions are based upon the assumptions that an area can and ultimately will be successfully reclaimed. This will minimize impacts to both soils and vegetation throughout the project area.

4.4.2. Soils Susceptible to Severe Erosion

Onsite investigations confirmed soils susceptible to erosion identified from NRCS SSURGO data. Onsite investigation identified additional areas of soils susceptible to erosion throughout the project area. All wells and/or associated infrastructures were identified during the onsite to have areas of soils susceptible to erosion.

There are 4 wells locations and 1.5 miles of access road with utility corridor that will impact approximately 12 acres of soils with severe erosion potential. Typically, the proposed disturbance is associated with developing improved roads where lesser (pioneered) roads exist and are failing to accommodate runoff and control erosion. BLM determined accepting additional disturbance in these severe erosion areas was preferable to as these routes were the only practical options through the broken terrain.

4.4.3.Limited Reclamation Potential (LRP)

Evaluation of the NRCS SSURGO data and subsequent onsite field inspections identified site conditions for well pads and access roads within areas of limited reclamation potential, namely badlands and rock outcrop components.

The 4 wells and associated roads and infrastructure that discussed above will also impact LRP areas. Typically BLM identifies LRP areas as avoidance areas however, utilizing existing disturbance areas is preferred to creating new disturbance areas in this challenging topography. These sites may be the result of poor construction, stabilization and/or reclamation practices from previous oil and gas activities. Disturbance in these areas are difficult if not impossible to meet the goals of the WY-BLM reclamation policy, control erosion, and the suitability of the material for construction (roads, pad, etc.) is in question. However, these sites have been previously disturbed and Anadarko has submitted site specific reclamation plans listed in Table 4.2 that describe the limiting soil factors present as well as BMPs to minimize further degradation. BLM determined this to be preferable, have less environmental impacts, than brand new disturbance on better soils.

Most landscapes can be reclaimed using established conventional reclamation methods. However, some areas have unique characteristics that make achieving all the reclamation requirements unrealistic. Areas

posing the most extreme reclamation challenges include steep slopes. Such is the case with the well locations, access roads and utility corridors identified in Table 4.4 impacting key features i.e. highly sensitive and erosive soils, extremely sensitive vegetation types, soils with severe physical or chemical limitations especially when associated with steep slopes exceeding 25percent.

Surface occupancy or use within slopes in excess of 25 percent is restricted or prohibited unless the operator and BLM arrive at an acceptable plan for mitigation of anticipated impacts. BLM will strongly consider avoidance in order to retain the project within the parameters of the PRB ROD and the Wyoming Reclamation Policy. This is in line with BLM BFO's land use plans to avoid impacts to slopes in excess of 25 percent.

4.4.3.1. Slope in Excess of 25 Percent

Slopes 25 percent and greater were identified using imagery from a 10 meter digital elevation model (USGS 2010) and then verified during the onsite inspections. Approximately 6.3 acres of surface disturbance is proposed on slopes greater than 25 percent. Most of the areas of impact are slopes greater than 25 and even 35 percent that occur on previously disturbed sites; specifically the cut and fill slopes of existing access roads. Again, BLM determined that using existing disturbance would have fewer environmental effects than brand new disturbance in this difficult topography.

During the production phase of the project, the operator committed to reduce the cut and fill slopes at the 10 constructed well pads to the approximate original contour and maintain them for the life of the well. Ditch slopes along the 2.8 miles of new constructed road will be maintained at 2:1 slopes or less for the life of the project. Steeper ditch slope allow for less overall disturbance but slopes steeper than 3:1 are difficult if not impractical to establish vegetation on. Until vegetation is reestablished, these constructed slopes will be bare ground void of vegetation with the fill slopes being less stable due to soil mixing. Sediment transport from the surface disturbance areas is likely to be extensive even with the proposed design features implemented. Expedient revegetation is key to maintaining soil stability.

The project wide and site-specific reclamation plans and the COA document include measures for both interim and final reclamation. Interim reclamation consists of minimizing the footprint of disturbance by reclaiming all portions of construction disturbance not needed during production operations. Final reclamation would meet reclamation performance standards and guidelines outlined in the Wyoming BLM Reclamation Policy. These actions would notably reduce intensity of the impacts to soils as well as the estimated time it would take to return the disturbed soils to a stable and productive state.

4.4.3.2. Cumulative Effects

Designations for disturbance duration are defined in the PRB FEIS (pp. 4-1 and 4-151). Over half (approximately 60%) of the soil disturbances would be short term with expedient interim reclamation and site stabilization, as required by the BLM. The proposed project represents 0.65 percent of land surface (disturbance) within the 1,840 acre POD boundary.

The effects of surface disturbance can range from chronic, long-term contributions of sediment into surface waters to catastrophic effects associated with mass failures of road fill material during large storms. Roads can increase the natural geomorphic processes. These geomorphic processes include: accelerated erosion from the road ways causing mass soil movement such as gullies and slope failures; and altering surface flow paths directly affecting stream channel structure and geometry leading to diversion or extension of channels onto previously channelized portions of the landscape. Events such as these cause degradation the landscape through irrecoverable soil loss.

These impacts, singly or in combination, could increase the potential for soil loss due to increased water and wind erosion, invasive/noxious plant spread, invasion and establishment, and increased sedimentation and salt loads to the watershed system.

4.4.3.3. Mitigation Measures

Operator committed measures described in the SUPO, and the KDUE2l Reclamation Plan (BKS) will be followed.

BLM reclamation goals emphasize ecosystem reconstruction, which means returning the land to a condition approximate to an approved "Reference Site" or NRCS Ecological Site Transition State. Final reclamation measures are used to achieve this goal. BLM reclamation goals also include the short-term goal of quickly stabilizing disturbed areas to protect both disturbed and adjacent undisturbed areas from unnecessary degradation. Interim reclamation measures are used to achieve this short-term goal.

To ensure soil and vegetation resources are adequately mitigated and that the reclamation goals are met, Conditions of Approval (COAs) listed below shall apply to the KDUE2 POD that will limit the extent of vegetation loss and surface disturbance, ensure sound construction practices and require expedient implementation of appropriate erosion and sediment control measures as well as interim reclamation. Subsequent monitoring of soil stability and reclamation success coupled with adaptive management will facilitate conformance with the reclamation objectives.

Topsoil stored for a period greater than 90 days will not exceed piles of 3 feet in depth and will be seeded with the BLM-approved seed mix to prevent wind and water erosion.

Erosion control fabric used for reclamation of steep slopes should be photodegradable or biodegradable. Non-photodegradable/biodegradable erosion control fabric will be removed from the federal leases following establishment of a self-perpetuating native plant community and sustained soil stability.

In the absence of manufacturer's specifications included in the operator's SUPO, erosion control fabric will be installed as follows:

a. The fabric will be 'keyed' into the slope by digging a small trench at the top of the slope;
b. Lay the top end of the material into the trench to line it;
c. To line it the edge is folded underneath itself and then it is secured using staples;
d. The trench is then filled in to the previous soil level; and
e. Fabric should be overlapped no less than 0.3 meter on edges and stapled on 1 meter spacing and at every seam.

Stabilization of steep slopes greater than 4H:1V will include but is not limited to the following components to minimize soil erosion and loss of seed:

a. Surface roughening/pocking or scarification perpendicular to the slope;
b. Install slope breakers such as waddles and water bars at the appropriate spacing;
c. Seed with appropriate seed mix; and
d. Apply straw mulch or bio/photodegradable erosion control fabric on highly erodible soils.

Straw/Excelsior wattles are most effective as erosion control if applied on slopes less than 3H:1V. In the absence of manufacturer's specifications included in the operator's MSUP, the minimum spacing requirements will be as follows:

Slope	6-inch waddle	9-inch waddle	12-inch waddle
≤4H:1V	20 feet	40 feet	60 feet
3H:1V	15 feet	30 feet	45 feet
2H:1V	10 feet	20 feet	30 feet
1.5H:1V	5 feet	10 feet	15 feet

All pit spoil must be placed back in the pit once the pit is dry or fluids are removed. Subsoil must then be replaced in the reserve pit before topsoiling. Under no circumstances would any by-products from drilling or subsoil to be spread on top of topsoil. The pit area should usually be mounded slightly or restored to the original contour to allow for settling and positive surface drainage.

The KDUE2 Project area is dominated by steep slopes and/or fragile soils. Improved roads used in conjunction with accessing federal wells must be fully built (including all water control structures such as wingditches, culverts, relief ditches, low water crossings, surfacing, et. cetera) and functional to BLM standards as outlined in the BLM Manual 9113 prior to drilling of the well. This applies to the ENTIRE KDUE2 project area. This measure will help to improve the overall safety and reduce erosion and sedimentation relative to the use of incomplete roads at insufficient stages of completion.

The operator is responsible for having the licensed professional engineer(s) certify that the actual construction of the road meets the design criteria and is constructed to BLM standards.

For safety of travel, to reduce rutting and increase traction, place a minimum average of 4 inches of aggregate on road segments where grades exceed 8%.

On cut-slope sections of road and other sections of road where topography on one side of the road does not allow the use of lead-out (wing) ditches to relieve road ditch flow, laterals in the form of culverts, water bars, or drainage dips **shall be placed according to the following minimum spacing**:

Lateral Spacing (Feet)				
Soil Type	**Road Grade 2-4%**	**Road Grade 5-8%**	**Road Grade 9-12%**	**Road Grade 13-16%**
Highly erosive granitic or sandy	240	180	140	100
Intermediate erosive clay or clay/silt/sand	310	260	200	150
Low erosive shale or gravel	400	325	250	200

NOTE: Sometimes laterals and lead-out ditches are constructed following spacing guidelines without regard to best placement of these structures. For this reason, experienced personnel who see how the road operates for years after construction or, preferably, road design engineers, should direct the placement of these structures to ensure that a sufficient number are constructed and that they are placed in locations that do not worsen hillside erosion below the discharge point. Over about the last 5-7 years, laterals and lead-out ditches have often been inadequately utilized, with contractors instead relying on coir logs to slow down ditch flow to non-erosive velocities. Coir logs should only be used in addition to properly placed laterals and lead-out ditches to help vegetation to get established.

Laterals shall be constructed with a durable ditch block just downstream of the inlet and the flow through laterals shall be discharged into a lead-out ditch as soon as is practicable. For culverts used as laterals, thick-walled plastic SDR9 pipe (or pipe with similar crushing resistance characteristics) 12 inches or larger in diameter may be used in-lieu of 18-inch CMP. Minimum cover for these pipes shall be 6 inches (minimum cover for CMP is 12 inches or one-half the diameter, whichever is greater).

To the extent that is beneficial and feasible, lead-out ditches shall be placed between laterals and uphill of the most uphill lateral in order to reduce flow in the road ditch at the exit of the next downhill lateral, especially on steeper slopes.

Where laterals are not needed, the road shall be constructed to ensure that flow does not concentrate and water does not pond next to the road. As is necessary, lead-out ditches shall be constructed to ensure that water is dispersed away from the road according to the minimum spacing given for laterals.

Road runoff shall not be directed into pre-existing eroded features (including small steep hillside channels with no discernible floodplain or riparian vegetation), but instead will be put to beneficial use by routing lead-out ditches away from eroded features and onto stable soils. Lead-out ditches and laterals shall be constructed as close as practicable to crossings (e.g. on the crossing approaches or just before the approach) in order to reduce the amount of ditch water and sediment directly entering drainages.

4.4.3.4. Residual Effects

Residual effects were identified in the PRB FEIS at p. 4-408, such as the loss of vegetative cover, despite expedient reclamation, for several years until reclamation is successfully established. Site stabilization, effective erosion control, and successful reclamation are unlikely for surface disturbance proposed on slopes greater than 35%, soils with severe erosion potential and LRP areas, despite the mitigation and reclamation plans in those sensitive areas. Disturbance in these areas is likely to compromise the health and productivity of the surrounding lands through sediment transport and contamination.

4.5. Vegetation and Ecological Sites

4.5.1. Direct and Indirect Effects

Direct and indirect effects to ecological sites are discussed in the PRB FEIS, pp. 4-153 to 4-164. As proposed, the project could potentially alter the disturbance regimes in the project area, especially the frequency of fire due to increased activity in the project area. Additional effects include the increase in noxious weeds and alterations in vegetation community diversity and cover.

Direct and indirect effects to vegetation are discussed in the PRB FEIS (pp. 4-153 to 4-164). Direct effects to vegetation would occur from ground disturbance caused by construction of well pads, ancillary facilities, associated pipelines, and roads. Short-term effects would occur where vegetated areas are disturbed and reclaimed to the performance goal standards within 1 to 3 years of the initial disturbance. Long-term effects would occur where well pads, roads and utility corridors would result in loss of vegetation for the life of the project. Indirect effects, as described in the PRB FEIS, would include the spread and/or establishment of noxious weeds, the alteration in surface water flows affecting vegetation communities, alteration in ecosystem biodiversity, and changes in wildlife habitat. These impacts would be mitigated by expediently stabilizing the disturbance through interim reclamation, and the implementation of erosion control measures.

Areas that are difficult to reclaim include sandy sites and areas where the parent material is very shallow (typically less than 10 inches deep). These areas were identified during initial site visits. On-the-ground alternatives were limited but where alternatives were identified by BLM, the operator typically chose to implement them. The plant communities on these areas can be difficult to re-establish, especially in areas where depth to parent material is shallow.

Long-term impacts to sagebrush are anticipated due to slow recovery rates and the duration between construction and final reclamation. Complete restoration of sagebrush shrubland after disturbance can often take decades. Studies of Wyoming big sagebrush post fire recovery intervals indicated that natural

post-fire regeneration of this species can take 50 to 120 years (Cooper et al. 2007, Baker 2006). Wyoming big sagebrush took approximately 17 years to re-establish after chemical removal in Wyoming (Johnson 1969) and sagebrush species can take 3 to 7 years to begin to spread in locations where seed drilling or transplant of seedlings occurred (Tirmenstein 1999).

4.5.2. Cumulative Effects

Cumulative effects to ecological sites are discussed in the PRB FEIS, pp. 4-153 to 4-172. Cumulative effects to ecological sites include the further alteration of disturbance regimes from the increased activity, increase in noxious weeds, and alterations in vegetation community's diversity and cover.

Cumulative effects to vegetation from oil and gas development are discussed in the PRB FEIS, pp. 4-164 and 4-172. As stated earlier, most surface disturbances would result in short-term impacts to herbaceous plant communities related to construction activities that would be reclaimed through interim reclamation and site stabilization, as committed to by the operator and as required by the BLM in COAs. The proposed project will remove all vegetative cover from the soil across approximately 0.65 percent of land surface within the POD boundary.

4.5.3. Mitigation Measures

Impacts to vegetation from surface disturbance will be mitigated through the implementation of the COAs listed below and presented in the COA document for the KDUE2 POD, and the POD's associated plans including the IPMP, Site-Specific Reclamation Plans, the WMP, and the SUPO (specifically Section 10, Plans for Reclamation of the Surface). These documents are included in the Administrative Record for the KDUE2 POD at the BFO.

To promote site stabilization and successful revegetation, interim reclamation (associated with temporary/construction activities) and final reclamation (associated with permanent/operation activities after production ceases) would be completed pursuant to methods and timing listing in the POD and COA document. In addition, the operator will follow the guidance provided in the Wyoming Policy on Reclamation (Instruction Memorandum WY-12-032). The Wyoming Reclamation Policy applies to all surface-disturbing activities. Authorizations for surface-disturbing actions are based upon the assumptions that an area can and ultimately will be successfully reclaimed through the implementation of final reclamation measures. BLM reclamation goals also include the short-term goal of quickly stabilizing disturbed areas to protect both disturbed and adjacent undisturbed areas from unnecessary degradation.

Anadarko has developed seed mixes for each soil type identified within the project area consistent with the NRCS ecological site description, the reference plant community and desired species richness with the intent of maximizing revegetation potential. See page 16 of the KDUE2 General Reclamation Plan. The operator will seed on the contour to a depth of no more than 0.5 inch. To maintain quality and purity, certified seed with a minimum germination rate of 80 percent and a minimum purity of 90 percent will be used. If the operator's seed mix is not available, the BLM's developed seed mixes listed in the Appendix B, Attachment 5 pp.18-25 of the Fortification Creek Planning Area RMPA will be used.

Soil compaction will 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 or shallow soils in the SUPO.

The KDUE2 project area is dominated by soils that have been identified to have poor reclamation suitability that will require disturbed areas to be stabilized (stabilization efforts may include mulching, matting, soil amendments, et. cetera) in a manner which eliminates accelerated erosion until a self-perpetuating native plant community has stabilized the site in accordance with the Wyoming Reclamation

Policy. Stabilization efforts shall be finished within 30 days of the initiation of construction activities. This applies to the ENTIRE Project area including all linear features (i.e. improved roads and utility corridors) within the ENTIRE KDUE2 Project area.

All trees salvaged from the construction of the well locations/access roads will be clearly segregated from the spoil material, to prevent burying of trees in the spoil material.

No salvaged trees will be pushed up against live trees or buried in the spoil material.

All salvaged trees will either be chipped and used in reclamation of the well location/access road, hauled off, used for erosion control or per the surface owner's wishes.

Improved roads with utility corridor clearing and blading width will not exceed 50 feet in width unless a specific design is included in the plan and profile section of the road design diagrams dated December 17, 2014.

Utility corridors adjacent existing roads working width will not exceed 45 feet from the centerline of the road with a clearing and blading not to exceed 35 feet in width unless a specific design is included in the plan and profile section of the master surface use plan and/or as specified on Project Facility Map A dated October 9, 2014.
Pipeline installation and/or corridors without road access working width will not exceed 45 feet with a clearing and blading not to exceed 35 feet in width unless a specific design is included in the plan and profile section of the master surface use plan and/or as specified on Project Facility Map A dated October 9, 2014.

Mowing at the well site where a constructed pad is not approved as designed will be minimized to the defined work space delineated on the well site diagram for the APD, or less, within sites where sagebrush is the dominant vegetation type.

4.5.4. Residual Effects

The alteration of biodiversity of ecological sites could result from changes in disturbance regimes, alterations in vegetation in reclaimed areas, and the spread and establishment of weed species.

Residual effects were identified in the PRB FEIS, p. 4-408, such as the loss of vegetative cover for several years until reclamation is successfully established. However, in those sensitive soil areas (steep slopes, LRP, highly erosive soils, etc,) reclamation is unlikely to successfully stabilize disturbed soil and prevent erosion. In the event the operator fails on their obligation to successfully reclaim the area as defined by the Wyoming Policy on Reclamation (Instruction Memorandum WY-90-231), the bond will not be released for the site and the BLM will be responsible for site reclamation.

4.6. Water Resources

The Water Management Plan (WMP) describes the disposal of CBNG produced water utilizing existing infrastructure to be directly discharged into a tributary of Turner Draw or directly discharged to the Powder River.

Discharge to the tributary of Turner Draw was approved as an option associated with the original Kinney Divide Unit Gamma POD WPM incorporated here by reference.

Produced water collected at the existing Camp John and Augusta Water Pump Station and conveyed via

the existing Camp John pipeline lateral to the existing Barber Creek water treatment facility located at NENW Section 9, T50N, R77W. Discharge is to the Powder River using existing Wyoming Department of Environmental Quality (WDEQ) permitted outfalls. The water pump station facility was analyzed under the Augusta Unit Zeta POD (WY-070-EA08-154). The site was originally analyzed for a water treatment facility associated with the Camp John and Augusta POD (WY-070-EA05-373). The following water treatment facility and associated existing infrastructure listed in Table 2.3 was analyzed for use in association with the preferred water management strategy for the POD.

The WMP for the KDUE2 POD is incorporated-by-reference into this EA pursuant to 40 CFR 1502.21. The WMP incorporates sound water management practices permitted and regulated by the WDEQ, WSEO, and the WOGCC, monitoring of downstream impacts within the Upper Powder River watershed, and commitment to comply with Wyoming State water laws/regulations. Adherence with the plan, in addition to BLM-applied mitigation (in the form of COAs), would reduce project area and downstream impacts from proposed water management strategies.

Produced Water Quality, Control, and Quantity

The maximum water production is predicted to be 20 gallons per minute (gpm) per well or 320gpm total from the 16 wells for this POD The PRB FEIS projected the total amount of water that was anticipated to be produced from CBNG development per year (PRB FEIS Table 2-8, Projected Amount of Water Produced from CBM Wells Under Alternatives 1, 2A and 2B, p. 2-26). For the Upper Powder River sub-watershed, the projected volume of produced water within the sub-watershed area was 5,672 acre-feet in 2014 (maximum production was estimated in 2006 at 171,423 acre-feet). As such, the volume of water resulting from the production of these 16 wells is 9.1 percent of the total volume projected for 2014 in the Upper Powder River sub-watershed. This volume of produced water is within the predicted parameters of the PRB FEIS.

No on-site surface discharge is proposed within the KDUE2 POD boundary. Therefore, no infiltration near surface discharge points or impoundments would occur within the KDUE2 POD boundary. Saturation of near-surface alluvium by production water would not occur within the KDUE2 POD boundary.

The water quality from the target coal zones is predicted to be similar to the sample water collected from a location near the POD. Table 4.4 shows the average values of EC and SAR as measured at the USGS gaging station, Powder River at Arvada, at high and low monthly flows as well as the Wyoming groundwater quality standards for TDS and SAR for Class I to Class IV water (there is no current standard for EC). The table also provides the concentrations of TDS, SAR, and EC found in the POD's representative water sample. Additional water quality data are presented in the WMP and are incorporated by reference.

In order to determine the actual water quality of the producing formations in this POD and to verify the water analysis submitted for the pre-approval evaluation, the operator committed to designate a reference well to each coal zone within the POD boundary. The reference well would be sampled at the wellhead for analysis within sixty days of initial production. A copy of the water analysis would be submitted to the BLM. Refer to the WMP filed with the POD for more information. The administrative record is available for review at the BFO.

Table 4.3 Comparison of Regulated Water Quality Parameters to Predicted Water Quality

Sample Location or Standard	TDS mg/l	SAR	EC µmhos/cm
Powder River at Arvada, Wyoming (USGS 06317000)[1] Historic Data Average at Maximum Flow	n/a	4.76	1,797

Table 4.3 Comparison of Regulated Water Quality Parameters to Predicted Water Quality

Sample Location or Standard	TDS mg/l	SAR	EC µmhos/cm
Historic Data Average at Minimum Flow		7.83	4,800
WDEQ Quality Standards-Wyoming Groundwater [2]			
Drinking Water (Class I)	500	n/a	n/a
Agricultural Use (Class II)	2,000	8	n/a
Livestock Use (Class III)	5,000	n/a	n/a
Predicted Produced Water Quality[3]			
Wall Coal Zone	925	19.8	1,480

[1]USDI BLM 2003a.

[2]WDEQ Water Quality Rules and Regulations, Chapter 8; 2005.

[3] KDUE2 WMP 2014 WQ sample Lab#G12110035-001dated 11/28/12

4.6.1. Groundwater

4.6.1.1. Direct and Indirect Effects

The PRB FEIS predicts that one of the environmental consequences of coal bed natural gas production is impacts to the groundwater. "The effects of development of CBM on groundwater resources would be seen as a drop in the water level (drawdown) in nearby wells completed in the developed coal aquifers and underlying or overlying sand aquifers" (PRB FEIS p. 4-1). Additionally, the Fortification Creek RMPA predicts CBNG development could "have a major impact [>30% increase] on aquifer [drawdown] in the" Project area (USDI BLM 2011b).

In the process of dewatering the coal zone, this project may affect the static water level of wells in the area. The WMP states that there are 3 registered stock water wells within a 1 mile radius of the proposed POD wells (Anadarko WMP, Attachment C). Well depths range as deep as 420 feet with static water levels in the wells at 30 feet below ground surface. The coal zone targeted for CBNG development and dewatering range in depths below ground surface from 2,280 to 2,500 feet (Anadarko drilling plan, pp1). The operator has committed to offer water well agreements to holders of properly permitted domestic and stock wells within the circle of influence (0.5 mile of a federal CBNG producing well) of the proposed wells.

Recovery of the coal bed aquifer was predicted in the PRB FEIS to "…re-saturate and re-pressurize the areas that were partially depressurized during operations. The amount of groundwater storage within the sand and coal units above and below the coals is enormous. Almost 750 million acre-feet of recoverable groundwater are stored within the Wasatch-Tongue River sands and coals (PRB FEIS Table 3-5). Redistribution is projected to result in a rapid initial recovery of water levels in the coal. The model projects that "this initial recovery period would occur over 25 years" (PRB FEIS p. 4-38).

4.6.1.2. Cumulative Effects

As stated in the PRB FEIS, "The aerial extent and magnitude of drawdown effects on coal zone aquifers and overlying and underlying sand units in the Wasatch Formation also would be limited by the discontinuous nature of the different coal zones within the Fort Union Formation and sandstone layers within the Wasatch Formation" (PRB FEIS p. 4-64).

Development of CBNG through 2018 (and coal mining through 2033) would remove an estimated 4 million acre-feet of groundwater from the coal zone aquifer (PRB FEIS p. 4-65). This volume of water "…cumulatively represents 0.5 percent of the recoverable groundwater stored in the Wasatch – Tongue River sands and coals (nearly 750 million acre-feet, from Table 3-5). All of the groundwater projected to be removed during reasonably foreseeable CBNG development and coal mining would represent less than

0.3 percent of the total recoverable groundwater in the Wasatch and Fort Union Formations within the PRB (nearly 1.4 billion acre-feet, from Table 3-5)" (PRB FEIS p. 4-65).

4.6.1.3. Mitigation Measures

Adherence to the drilling COAs, the setting of casing at appropriate depths, following safe remedial procedures in the event of casing failure, and utilizing proper cementing procedures should protect fresh water aquifers above the target coal zone. Adherence to WDEQ permits and regulations will also mitigate impacts from produced water. This will ensure that groundwater will not be adversely impacted by well drilling and completion operations.

4.6.1.4. Residual Effects

As described in Section 3.5, the production of CBNG in this project area has already lowered the water saturation in the coal zones for the production of gas. The drawdown due to existing development has exceeded the modeled drawdown in the PRB FEIS (pp. 4-13 to 4-33, Layer 14). This POD is anticipated to draw ground water down an additional amount; however that amount has not been quantified; there are too many variables to quantify reliably.

4.6.2. Surface Water

4.6.2.1. Direct and Indirect Effects

The produced water will be directly discharged, to the Powder River and a tributary of Turner Draw 1 mile upstream from the Powder River. The water facilities, treatment plant, and discharge points were analyzed in previous EA's as discussed above in Section 2. Based on the analysis performed in the PRB FEIS, the primary beneficial use of the surface water in the PRB is the irrigation of crops (PRB FEIS, p. 4-69). The water quality projected for this POD has a maximum predicted TDS of 925mg/l, which is within the WDEQ criteria for agricultural use (2,000 mg/l TDS).

Storm Water Controls

A WYPDES non-point source permit for construction activities would address potential surface water impacts from storm water runoff. The potential for in-channel impacts, and proposed measures to avoid or mitigate them including compliance with USACE Nationwide Permits 3, 12, and 14, are addressed in the WMP for this POD.

All culverts would be designed and installed in accordance with BLM guidelines. Based on the project proposal, including the WMP and operator-committed mitigation measures, negligible impacts to stream channels or banks would result from road crossings.

4.6.2.2. Cumulative Effects

The analysis in this section includes cumulative data from fee, State and Federal CBNG development in the Upper Powder River sub-watershed. These data were obtained from the WOGCC.

As of December 2013, all producing CBNG wells in the Upper Powder River sub-watershed have discharged a cumulative volume of 99,806 acre-ft of water (WOGCC 2013) compared to the predicted 1,275,921 acre-ft disclosed in the PRB FEIS (Table 2-8 p. 2-26). This volume is 31.3 percent of the total predicted produced water analyzed in the PRB FEIS for the Upper Powder River sub-watershed. These volumes are tabulated in Table 4.5.

Table 4.4 Actual vs Predicted Water Production in the Upper Powder River Watershed *2013 Data Update 05-08-2014*

Year	Upper Powder River Predicted (Annual acre-feet)	Upper Powder River Predicted (Cumulative acre-feet from 2002)	Upper Powder River Actual (Annual acre-feet)		Upper Powder River Actual (Cumulative acre-feet from 2002)	
			A-ft	% of Predicted	A-Ft	% of Predicted
2002	100,512	100,512	15,846	15.8	15,846	15.8
2003	137,942	238,454	18,578	13.5	34,424	14.4
2004	159,034	397,488	20,991	13.2	55,414	13.9
2005	167,608	565,096	27,640	16.5	83,054	14.7
2006	171,423	736,519	40,930	23.9	123,984	16.8
2007	163,521	900,040	42,112	25.8	166,096	18.5
2008	147,481	1,047,521	45,936	31.1	212,522	20.3
2009	88,046	1,135,567	43,079	48.9	255,601	22.5
2010	60,319	1,195,886	43,263	71.7	298,864	25.0
2011	44,169	1,240,055	43,163	97.7	342,027	27.6
2012	23,697	1,263,752	31,755	134.0	373,782	29.6
2013	12,169	1,275,921	26,024	213.9	399,806	31.3
2014	5,672	1,281,593				
2015	2,242	1,283,835				
2016	1,032	1,284,867				
2017	366	1,285,233				
Total	**1,285,233**		**399,806**			

The PRB FEIS identified downstream irrigation water quality as the primary issue for CBNG produced water. EC and SAR are the parameters of concern for suitability of irrigation water. The water quality analysis in the PRB FEIS was conducted using produced water quality data, where available, from existing wells within each of the ten primary watersheds in the PRB. These predictions of EC and SAR can only be reevaluated when additional water quality sampling is available.

The PRB FEIS disclosed that cumulative impacts may occur as a result of discharged produced CBNG water. The cumulative effects relative to this project are within the analysis parameters and impacts described in the PRB FEIS for the following reasons:

1. They are proportional to the actual amount of cumulatively produced water in the Upper Powder River, which is approximately 27.6 percent of the total predicted in the PRB FEIS.
2. The WDEQ enforcement of the terms and conditions of the WYPDES permit that are designed to protect irrigation downstream.
3. The commitment by the operator to manage the volume of water discharged.

Refer to the PRB FEIS, Volume 2, p. 4-115 to 4-117 and Table 4-13 for cumulative effects relative to the watershed and p. 117 for cumulative effects common to all sub-watersheds.

4.6.2.3. Mitigation Measures

Culverts will be installed at appropriate locations for streams and channels crossed by roads as specified in the BLM Manual 9112-Bridges and Major Culverts and Manual 9113-Roads. Streams will be crossed perpendicular to flow, where possible, and all stream crossing structures will be designed to carry the 25-year discharge event or other capacities as directed by the BLM.

There are no proposed surface water discharge points within the KDUE2 POD. Direct discharge of treated produced water will occur via the previously analyzed facilities identified above. If erosion is noted, the operator will be required to repair and stabilize the area using selected mitigation techniques.

4.6.2.4. Residual Effects

The lifespan of a CBNG POD project is estimated to last ten years if the wells are in producing mode during the whole ten year span. Once the wells have been plugged and abandoned, there should not be any noticeable residual effects to the environment if reclamation is completed to BLM standards.

4.6.3. Wetlands/Riparian

Effects to wetland/riparian areas from oil and gas development are discussed in the PRB FEIS, pp. 4-178 and 4-179. This project does not propose surface disturbance that will directly impact the 2 wetlands identified within the project area. Indirect, construction-related impacts to wetland/riparian areas would be minimized through interim reclamation and site stabilization, as committed to by the operator and as required by the BLM in COAs.

BLM analyzed effects to wetlands associated with CBNG development in the Kinney Divide Unit Epsilon POD EA, WY-070-EA12-148, pp. 42, incorporated here by reference. Effects associated with this project are similar in nature.

4.6.3.1. Mitigation

Channel crossings by road will be constructed perpendicular to flow. Culverts will be installed at appropriate locations for streams and channels crossed by roads as specified in the BLM Manual 9112-Bridges and Major Culverts and Manual 9113-Roads. Streams will be crossed perpendicular to flow, where possible, and all stream crossing structures will be designed to carry the 25 year discharge event or other capacities as directed by the BLM. Channel crossings by pipelines will be constructed so that the pipe is buried at least four feet below the channel bottom.

4.6.4. Noxious Weeds and Invasive Species

Effects resulting from invasive and/or noxious weed species are discussed in the PRB FEIS, pp. 4-158 to 4-171. The surface disturbance associated with construction of proposed wells, access roads, pipelines, and related facilities would present opportunities for the introduction and spread of noxious weeds and invasive species. Following surface disturbance activities, noxious weeds and invasive species readily colonize areas that lack or have minimal vegetation cover.

BLM analyzed effects from noxious weed associated with CBNG development in the Kinney Divide Unit Epsilon POD EA, WY-070-EA12-148, pp. 42-43, incorporated here by reference. Effects and mitigation associated with this project are similar in nature.

4.7. Wildlife

4.7.1. Habitat Types

BLM analyzed effects to habitat types with CBNG development in the FCPA-RMPA pp. 4-49 to 4-77, incorporated here by reference and PRB FEIS on p. 4-408. Effects and mitigation associated with this project are similar in nature, with the following additional site-specific information. This project will result in a direct loss of approximately 42.5 acres of habitat, see Table 2.5. Effects to wildlife habitats

due to the proposed surface disturbances will be similar to effect discussed under Section 4.5 Vegetation and Ecological Sites above.

4.7.2. Big Game

The PRB FEIS discusses impacts, including direct and indirect effects, cumulative effects, and residual effects to big game on pp. 4-181 to 4-215. The FCPA RMPA discusses impacts, including cumulative effects, to elk, pp. 4-49 to 4-53, 4-67 to 4-73, and 4-74 to 4-78. BLM analyzed effect to big game associated with CBNG development in the Kinney Divide Unit Epsilon POD EA, WY-070-EA12-148, pp. 47-65, incorporated here by reference. Effects and mitigation associated with this project are similar in nature.

4.7.2.1. Elk

Appendix B of FCPA RMPA, incorporated here by reference, identifies seven performance standards designed to be used in conjunction with the FCPA RMPA. These will be used to achieve BLM goals and objectives for the FCPA. The goal is that a viable elk herd utilizing their seasonal ranges during the appropriate seasons is maintained across the FCPA. BLM analyzed effects to elk associated with CBNG development in the Kinney Divide Unit Epsilon POD EA, WY-070-EA12-148, pp. 47-62, incorporated here by reference. Effects and mitigation associated with this project are similar in nature with the following additional site-specific information.

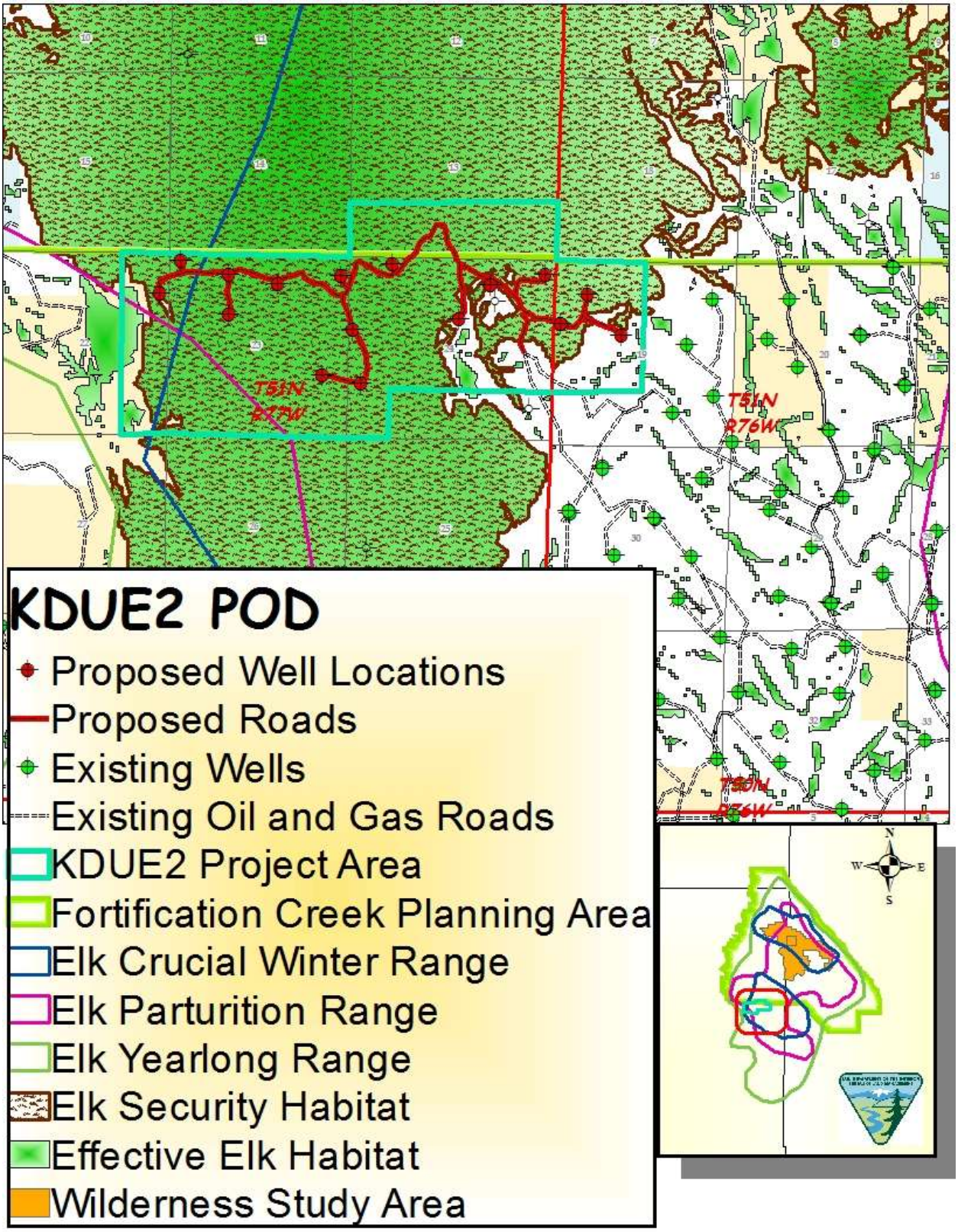
A portion of the KDUE2 POD boundary lies within the 24,850 acre Southwest Development Phase (SWDP) of the FCPA; 15,373 acres (61.9%) of which provides Elk Security Habitat (ESH). Construction of the proposed roads associated with the project will result in a loss of 679.1 acres of ESH from the SWDP. This is 4.4% of the allowable ESH loss from the SWDP under the FCPA-RMPA. There will be additional impacts to elk habitat that lies south of the FCPA boundary that is not subject to the RMPA's 7 performance standards. A total loss of approximately 1,704 acres of ESH and 1,576 acres of effective habitat is expected to be lost with full development of the project.

Fourteen of the 16 proposed wells lie within elk crucial winter range while all 16 fall within elk calving range. Approximately 1,458 acres of ESH will be lost within elk crucial winter range and 1,674 acres will be lost within elk calving ranges.

The FCPA-RMPA calls for an acceptable plan to be submitted by the operator for the protection of the elk herd. An acceptable plan would incorporate compliance with the FCPA-RMPA performance standards and allows for wells and oil and gas development in accordance with the FCPA-RMPA performance standards.

Timing limitations prohibit surface disturbing activities during the appropriate sensitive season(s) but would not preclude development. Timing limitations will prohibit surface disturbing activities within crucial winter range November 15-April 30 and parturition range May 1-June 30 annually. Elk crucial winter timing limitations will apply to the entire project area except NWNW Section 23 and NENE Section 22, T51N/R77W. Elk parturition timing limitations will apply to the entire project area. Expedient reclamation of disturbed soil will reduce the duration that elk are displaced from utilizing the effected habitat. In order to facilitate the timing limitation stipulations and expedient reclamation, for all wells spudded after November 1, the reserve pit fluids must be removed immediately following completion activities.

Figure 4.1 Elk Ranges, Security Habitat, Proposed and Existing Wells and Roads



4.7.3. Migratory Birds

4.7.3.1. Direct and Indirect Effects

The PRB FEIS discussed direct and indirect effects to migratory birds, pp. 4-231 to 4-235. The direct and indirect effects to migratory birds associated with this project are similar to those analyzed in the Sahara POD EA WY-070-EA13-72, 2013, Sections 3.7.2.2 (p. 16-17) and 4.6.2.2 (p. 31-33) incorporated here by reference. "Surface disturbance associated with construction, operation, and abandonment of facilities, including roads, has the potential to result in direct mortality of migratory birds. Most birds would be able to avoid construction equipment; however, nests in locations subject to disturbance would be lost, as would any eggs or nestlings." Direct mortality of a bird or destruction of an active nest due to construction activities could result in a "take" as defined (and prohibited) by the Migratory Bird Treaty Act (MBTA), a nondiscretionary statute. Additional information on the impacts to migratory birds, and its influence on cumulative effects from energy development can be found in the affected environment and environmental effects of the Sahara POD EA, WY-070-EA13-72, 2013, Sections 3.7.2.2 (p. 16-17) and 4.6.2.2 (p. 31-33) incorporated here by reference.

The BLM identified suitable nesting habitat throughout the project area for several BLM sensitive sagebrush obligates particularly Brewer's sparrow, sage thrasher and sage sparrow. This is supported by BHEC wildlife survey report page 9, incorporated here by reference. Brewer's sparrows were documented in the project area by BHEC on May 20, 2014.

The habitat includes sagebrush steppe community. Vegetative cover ranges between 50% along the access route and 75% at the well site even though the area has had of long-term, intense grazing operations. Migratory bird species in the PRB nest in the spring and summer and are vulnerable to the same effects as GSG and raptor species. Where GSG or raptor nesting timing limitations are applied, nesting migratory birds are also protected. Where these timing limitations are not applied and migratory bird species are nesting, migratory birds are vulnerable. Surface disturbing activities associated with construction of the well access road will have GSG and raptor timing limitations applied, thereby providing some protection to migratory birds.

4.7.3.2. Cumulative Effects

The cumulative effects associated with Alternative B are within the analysis parameters and impacts described in the PRB FEIS. For details on expected cumulative impacts, refer to the PRB FEIS, p. 4-235.

4.7.3.3. Mitigation Measures

In an effort to apply the least restrictive measures to be in compliance with the MBTA, while still conforming to Executive Order (EO) 13186 and the BLM/FWS MOU regarding conservation of species of concern, the BLM prohibits habitat removal for only those habitats where BLM special status (sensitive) species (SSS) migratory birds are likely to occur. The BLM applies a conditional surface use stipulation for all special status species to all oil and gas leases since 2008 (IM WY-2013-005, p. 2). To reduce the likelihood of a "take" under the MBTA, the BLM biologist recommends that well pad, access road, and pipeline construction (vegetation removal) occur outside of the breeding season for the greatest quantity of BLM SSS migratory birds (May 1- July 31) where suitable nesting habitat for sagebrush obligates is present. The restriction would apply to habitat removal, unless a pre-construction clearance survey (within approximately 10 days of construction planned May 1-July 31) is completed. If surveys will be conducted, the Operator will coordinate with BLM biologists to determine a protocol. At a minimum, the surveys will consist of nest searches in areas where vegetation will be removed or destroyed. The BLM recommends surveys prior to construction activities supporting the well pads as well as the proposed access roads and overhead power. The BLM will require surveys prior to construction activities supporting all the KDUE2 POD well pads, access roads and associated infrastructure. This condition applies to surface disturbing activities in the entire project area. Occupied habitat removal is prohibited during the nesting season for sagebrush obligate passerines (May 1 to July 31). Timing

limitations for active raptor nests (Feb 1 to July 31) which begins prior to timing limitations for sagebrush obligates, may provide additional protection where migratory bird nesting periods and habitats overlap.

The BLM recommends taking measures to ensure that migratory birds are excluded from all facilities that pose a mortality risk, including, but not limited to reserve pits, and standing water or chemicals where escape may be difficult or toxic substances are present.

4.7.3.4. Residual Effects

With the habitat removal restriction is applied, it is unlikely that active nests (of BLM sensitive species) will be destroyed, as most nestlings will have fledged by the beginning of August. Nests initiated after the first week in July may be destroyed by construction after August 1st. Ground nesting birds using grassland habitats in the proposed disturbance areas, may have nests or young destroyed if construction occurs during the nesting season; BLM sensitive migratory bird species are not anticipated to nest in the disturbance areas following construction activities. Migratory birds nesting adjacent to the well pads or roads may be displaced, abandon nests, or suffer reduced reproductive success due to construction and production activities. Suitability of the project area for migratory birds will be negatively affected due to habitat loss and fragmentation, and proximity of human activities from oil and gas development.

4.7.4. Raptors

4.7.4.1. Direct and Indirect Effects

Direct and indirect impacts to raptors, from oil and gas development, are analyzed in the PRB FEIS, pp. 4-216 to 4-221. No direct impacts to raptor nests are anticipated from the project. However, indirect impacts may occur as a result of project activities. This project will result in disturbance in proximity of nesting raptors, including direct loss of foraging habitats and indirect losses associated with declines in habitat effectiveness. There are 4 known raptor nests within 0.5 miles of project components and suitable nesting habitat is present throughout the project area. Two of the nests were active with young in the nest when surveyed in 2014. To reduce the risk of decreased productivity or nest failure, the BFO requires a 0.5-mile radius timing limitation during the breeding season around active raptor nests and recommends all infrastructures requiring human visitation be sited to provide adequate biologic buffer for nesting raptors. A biologic buffer is a combination of distance and visual screening that provides nesting raptors with security such that they will not be flushed by routine activities. Construction, drilling and production could deter raptors from selecting a nest site in the vicinity of the new well location. If Anadarko would voluntarily restrict well site visits and work-over operations at the well location during the raptor breeding season, raptors may not avoid selecting the area for nesting. The operator did not volunteer any such mitigation and such a measure is more restrictive than BLM-BFO land use plans provide. Additional direct and indirect impacts to raptors, from oil and gas development, are analyzed in the PRB FEIS, pp. 4-216 to 4-221.

4.7.4.2. Cumulative Effects

It is likely that impacts to raptors will be greater than those analyzed in this EA as there is existing overhead powerline owned by a “third party” and not Anadarko so it is uncertain where those powerlines will actually fall on the landscape - making it impossible at this time to adequately analyze the impacts of overhead powerline. Dependent on how productive the wells are will dictate the number of workover operations at each site and the level of disruptive activity raptors in the vicinity will endure. The cumulative effects associated with Alternatives B are within the analysis parameters and impacts described in the PRB FEIS, p. 4-221.

4.7.4.3. Mitigation Measures

Measures intended to avoid, minimize, and mitigate impacts to raptors are outlined in the COA document, including operator committed measures and site-specific COAs. For example, to reduce the risk of adverse impacts to nesting raptors, no surface-disturbing activity will occur within 0.5 mile of all

identified raptor nests from February 1 through July 31, annually, prior to a raptor nest occupancy survey. Surveys shall be conducted by a biologist following the most current BLM protocol. All survey results must be submitted in writing to the BFO and approved prior to initiation of surface-disturbing activities. A 0.5-mile timing restriction will be applied if a nest is identified as active. Additionally, the following resource and site-specific BLM COAs will be implemented:

- No surface-disturbing activity shall occur within 0.5 mile of all identified raptor nests from February 1 through July 31, annually, prior to a raptor nest occupancy survey for the current breeding season. This timing limitation will affect surface disturbing activities located NENW, NWNE and NESE Section 23 and NWNW, NENW, SWNE and NWNE section 24 T51N R77W.
- Surveys to document nest occupancy shall be conducted by a biologist following BLM protocol, between April 15 and June 30. All survey results shall be submitted in writing to a Buffalo BLM biologist and approved prior to surface-disturbing activities. Surveys outside this window may not depict nesting activity. If a survey identifies active raptor nests, a 0.5 mile timing buffer will be implemented. The timing buffer restricts surface-disturbing activities within 0.5 mile of occupied raptor nests from February 1 to July 31.

4.7.4.4. Residual Impacts

There would be an increase in traffic, construction activity, and human presence in the area throughout the life of the project that would affect the quality of the area for nesting raptors. Timing limitations during the construction phase of the project would protect nests from disturbance, however, during well operation, well monitoring and maintenance disruptive activities would be allowed which could displace raptors from the nest locations. Due to the proximity of the wells and infrastructure to the nest sites, if raptors do choose to use these nest locations, then operation and maintenance activities during the nesting season may still lead to nest failure or reduced production, and eventual nest abandonment.

4.7.5. Upland Game Birds (Plains Sharp-tailed Grouse)

4.7.5.1. Direct and Indirect Effects

The PRB FEIS discusses impacts, including direct and indirect effects, and cumulative effects, to plains sharp-tailed grouse, pp. 4-221 to 4-226.

There are no known plains sharp-tailed grouse leks within the project area. The nearest known lek is located 2.4 miles south of the project area. Sharp-tailed grouse would be impacted by the proposed project because suitable nesting habitat exists throughout the project area. Construction and maintenance activities associated with development of the KDUE2 POD would cause direct habitat loss. Associated road networks, pipelines, and powerline transmission corridors would influence vegetation dynamics by fragmenting habitats and creating soil conditions that facilitate the spread of invasive species (Braun 1998, Gelbard and Belnap 2003).

4.7.5.2. Cumulative Effects

The cumulative effects associated with Alternative B are within the analysis parameters and impacts described in the PRB FEIS. Fragmentation of shrub steppe habitat is a major disruption that has consequences for sagebrush-obligate species (Braun et al. 1976, Rotenberry and Wiens 1980a). In fragmented habitats, suitable habitat area remains only as remnants surrounded by unusable environments (Urban and Shugart 1984, Fahrig and Paloheimo 1988). Sagebrush-obligate species decline when areas of suitable habitat decrease (Temple and Cary 1988), due to lower reproduction, and/or due to higher mortality in remaining habitats (Robinson 1992, Porneluzi et al. 1993). Fragmentation of shrub steppe has further potential to affect the conservation of sagebrush-obligate species because of the permanence of disturbance (Knick and Rotenberry 1995). Several decades are required to re-establish ecologically functioning mature sagebrush communities. Therefore, sagebrush obligate species may not return to the project area for many years after reclamation activities are completed.

4.7.5.3. Mitigation Measures

Measures to mitigate impacts to plains sharp-tailed grouse include the following site-specific COAs:

A survey is required for sharp-tailed grouse between April 1 and May 7, annually, within the project area for the duration of surface disturbing activities and results shall be submitted to a BLM biologist.

If an active lek is identified during survey, the 0.64 mile timing restriction (March 1-June 15) will be applied and surface-disturbing activities will not be permitted until after the nesting season.

4.7.5.4. Residual Effects

The effectiveness of the mitigation measures are limited because the timing limitation does not apply to well monitoring and maintenance. Impacts would span the life of the wells which is anticipated to be 10 years or more. Furthermore, the timing limitation does not apply to sharp-tailed grouse nesting habitat beyond 0.64 mile of leks.

4.7.6. Wildlife Threatened, Endangered, Proposed and Candidate Species

4.7.6.1. Ute Ladies'-Tresses Orchid

4.7.6.1.1. Direct and Indirect Effects

There are no known populations of Ute ladies'-tresses orchid or suitable habitat within the project area. Implementation of the proposed project would not affect the Ute ladies'-tresses orchid.

4.7.6.2. Northern Long-eared Bat

4.7.6.2.1. Direct and Indirect Effects

There are no known populations of northern long-eared bat within the project area. Implementation of the proposed project would not affect the northern long-eared bat.

4.7.7. Candidate Species, Greater Sage-Grouse

4.7.7.1. Direct and Indirect Effects

Biologists expect the direct and indirect impacts to Greater Sage-Grouse to be similar to those described in the KDUE POD environmental assessments, WY-070-EA12-148 pp 44-45 and incorporated here by reference. The 2010 FWS listing decision discussed impacts associated with energy development in detail. Impacts to Greater Sage-Grouse are generally a result of loss and fragmentation of sagebrush habitats associated with roads and infrastructure. Research indicates that yearling Greater Sage-Grouse hens also avoid nesting in developed areas, while older hens will continue nesting attempts in impacted habitats (Lyon and Anderson 2003, Holloran 2005, Holloran et al. 2010, FWS 2010).

Within the project area, approximately 1,075 acres of high quality nesting habitat for Greater Sage-Grouse has been modeled and mapped (58% of the project area). The onsite field visits and GSG surveys (BHEC 2014) verified the habitat quality recognizing that existing overhead power transmission lines and oil and gas development has compromised portions of the mapped habitat. Direct loss of approximately 42.5 acres of high-quality habitat from the facilities and roads is anticipated within the POD from full development of the 16 well locations, access roads, and associated infrastructure. For a specific breakdown of proposed disturbance see Table 2.5. Implementation of the project will adversely impact nesting habitat, both through direct loss and avoidance of the area by Greater Sage-Grouse.

4.7.7.2. Cumulative Effects

There are 9,811 wells according to the WOGCC database, January 27, 2015 (2,085 are abandoned) in the cumulative impact assessment area, an area of 1,658 square miles, which amounts to a density of approximately 5.9 wells per square mile. Currently, there are 172 proposed wells (WOGCC, January 27, 2015) (including the 16 from this project) within 12.4 miles of the 25 GSG leks. With the addition of the proposed wells, the well density within 12.4 miles of the leks would increase to 6.0 wells per square mile,

6 times the 1 well per square mile recommendation made by the State Wildlife Agencies' Ad Hoc Committee for Sage-Grouse and Oil and Gas Development. Table 4.6, below, shows the well density within the 12.4 mile analysis area.

Table 4.5. Well Density within the 12.4 Mile Impact Area

Analysis Area	Area mi^2	# of Existing & Approved Wells	Well Density (Existing)	Proposed Wells	Well Density (including proposed)
buffer of leks within 12.4 miles of the 1 well	1,658	9,811	5.9 wells/mi^2	172	6.0 wells/mi^2

4.7.7.3. Mitigation Measures

In order to reduce the impacts to GSG associated with noise, construction, and human disturbance resulting from implementation of the proposed project, BLM will require a timing limitation (March 15-June 30) on surface-disturbing activities to maintain connectivity between GSG leks surrounding the new well and access road. The BLM agreed to implement the State of Wyoming's Sage-grouse Core Area Strategy (IM 2012-019); which protects approximately 80% of GSG leks in the State. However in the PRB approximately 20% of leks are in core designated habitats, and the shape and size of the Buffalo priority habitats limits the protections afforded these leks. Additional mitigation may be necessary to maintain populations in the PRB. Such mitigation could include; increasing WNv control efforts, avoiding/minimizing surface water discharges, enhancing priority habitat quality, accelerating the pace of development by modifying or eliminating timing restrictions in some areas, efficiently suspending leases in (or habitats supporting) core, identifying areas in core, or undeveloped areas adjacent to core, that are appropriate for off-site mitigation, reducing supplemental predator habitat, and increased reclamation.

Aggressive reclamation of plugged and abandoned well fields, combined with habitat enhancements in functional core and supporting areas, may provide a population of birds to re-populate areas that can be successfully reclaimed. GSG habitat restoration efforts in the PRB are ongoing. The BLM identified historical GSG population centers that are ready for oil and gas reclamation where stakeholders will apply enhanced reclamation techniques. The intent is maintaining and enhancing those areas with remaining GSG and increase suitability of currently uninhabited areas that are important for connectivity. The WY BLM initiated the PRB Restoration Program to implement strategies for accelerated reclamation and GSG habitat restoration in areas affected by federal oil and gas developments.

BLM requires the following mitigation measures to reduce potential impacts to the GSG population:

- For surface disturbing activities proposed in sagebrush lands, the operator will conduct clearance surveys for Greater Sage-Grouse breeding activity during the Greater Sage-Grouse's breeding season before initiating the activities. The surveys must encompass all sagebrush shrublands within 0.5 miles of the proposed activities for the entire project area. This will apply to all approved wells and associated access roads, infrastructure and facilities. All survey results shall be submitted in writing to a BFO BLM biologist no later than July 31 of the current year. This condition will be implemented on an annual basis for the duration of the surface disturbing activities.
- If a previously unknown lek is identified during surveys (April 1-May 7), a BFO BLM biologist shall be notified.

4.7.7.4. Residual Effects

The PRB FEIS predicted that the PRB oil and gas development would have significant impacts to the GSG population. The impact of the this 16 CBNG well development cumulatively contributes to the potential for local GSG extirpation yet its effect is acceptable because it is outside priority habitats and is within the parameters of the PRB FEIS/ROD and current BLM and Wyoming GSG conservation

strategies. Current research does not identify specific components of energy development that BLM or operators can alter to measurably decrease impacts to GSG or functionality of their habitats. Even in areas where BLM applied a variety of mitigation measures, negative population impacts are still measurable when well density exceeds approximately 1 well per square mile. Management of energy development based on current priority habitat configurations and associated lease stipulations, conditions of approval, and best management practices (BMPs), may not provide enough contiguous habitats sufficient to protect the remaining population viability of PRB GSG without a substantial investment in restoration. The PRB FEIS based its analysis and decision, in part, on the removal of all CBNG wells and most infrastructures at final well abandonment after the CBNG played out 10-15 years after drilling. In areas that are or were important to GSG, leaving infrastructure on the landscape may hamper restoration (Taylor et al. 2012).

4.7.8. Sensitive Species

The PRB FEIS discusses impacts to sensitive species on pp. 4-257 to 4-265. BLM will take actions to meet the policies set forth in sensitive species policy (BLM Manual 6840). BLM Manual 6840.22A states that "The BLM should obtain and use the best available information deemed necessary to evaluate the status of special status species in areas affected by land use plans or other proposed actions and to develop sound conservation practices. Implementation-level planning should consider all site-specific methods and procedures which are needed to bring the species and their habitats to the condition under which the provisions of the ESA are not necessary, current listings under special status species categories are no longer necessary, and future listings under special status species categories would not be necessary."

4.7.8.1. Bald Eagle

4.7.8.1.1. Direct and Indirect Effects

Impacts to bald eagles are discussed in the PRB FEIS, pp. 4-251 to 4-253. A study completed in 2004 suggests that two-tracks and improved project roads pose minimal collision risk to bald eagles. In 1 year of monitoring road-side carcasses, the BFO reported 439 carcasses, 226 along Interstates (51 percent), 193 along paved highways (44 percent), 19 along gravel county roads (4 percent), and 1 along an improved CBNG road (less than 1 percent) (Bills 2004). No road-killed eagles were reported; bald and golden eagles were observed feeding on 16 of the reported road-side carcasses (less than 4 percent). The risk of big-game vehicle-related mortality along CBNG project roads is insignificant or discountable, when combined with the lack of bald eagle mortalities associated with highway foraging, leads to the conclusion that CBNG project roads do not affect bald eagles.

No bald eagle nests or winter roosts were identified within 1 mile of the project area. However, suitable habitat exists throughout the project area. In February 2007, 2 roosting bald eagles were observed along the Powder River nearly 1.5 miles west of the project area. Implementation of the proposed project would not likely adversely impact bald eagle nesting or roosting.

4.7.8.1.2. Cumulative Effects

Refer to the PRB FEIS, pp. 4-251 to 2-253, for the cumulative effects of Alternative B on bald eagles.

4.7.8.1.3. Mitigation Measures

The application of the BLM's 2010 MBTA MOU with the USFWS will serve to further mitigate potential effects to this migratory bird.

4.7.8.1.4. Residual Effects

No residual effects are anticipated to bald eagle nesting or roosting.

4.7.8.2. Ferruginous Hawk

4.7.8.2.1. Direct and Indirect Effects

The PRB FEIS discusses impacts, including direct and indirect effects, to sensitive species on pp. 4-257

to 4-273. Additional impacts expected from project actions are described in the Raptor Section, above. Additionally, due to the territorial nature of ferruginous hawks, there is greater potential for disturbance to nesting ferruginous hawks. However, no active ferruginous hawk nests were identified during the past survey efforts (BHEC 2014) and therefore, adverse impacts to this species are not anticipated. There is suitable ferruginous hawk nesting habitat throughout the project area. Adverse impacts to this species are not anticipated.

4.7.8.2.2. Cumulative Effects

The PRB FEIS discusses impacts, including cumulative effects, to sensitive species on pp. 4-257 to 4 273.

4.7.8.2.3. Mitigation Measures

An annual survey will be required for nesting raptors and a TLS will apply (February 1 through July 31) if an active ferruginous hawk nest is located.

4.7.8.2.4. Residual Effects

Residual effects will be similar to residual effects of other raptors.

4.7.8.3. Fringed Myotis and Long-eared Myotis

4.7.8.3.1. Direct and Indirect Effects

The PRB FEIS discusses impacts, including direct and indirect effects, to sensitive species on pp. 4-257 to 4-273.

4.7.8.3.2. Cumulative Effects

The PRB FEIS discusses impacts, including cumulative effects, to sensitive species on pp. 4-257 to 4 273.

4.7.8.3.3. Mitigation Measures

No additional mitigation measures are required.

4.7.8.3.4. Residual Effects

No residual effects are anticipated.

4.7.8.4. Aquatics Species

4.7.8.4.1. Direct and Indirect Effects

The PRB FEIS discusses impacts, including direct and indirect effects, to aquatic species on pp. 4-235 to 4 247. BLM analyzed effect to aquatics associated with CBNG development in the Kinney Divide Unit Epsilon POD EA, WY-070-EA12-148, pp. 63-64, incorporated here by reference. Effects and mitigation associated with this project are similar in nature. Produced water will be directly discharge to Turner Draw via an existing outfall. Additionally, Anadarko will discharge produced water an existing outfall tied to the existing treatment facilities at Barber Creek that discharges into the Upper Powder River.

4.7.8.5. West Nile Virus

4.7.8.5.1. Direct and Indirect Effects

This project is likely to result in very little standing surface water which may increase mosquito breeding habitat and therefore potential for WNv transmission.

4.7.8.5.2. Cumulative Effects

There are many sources of native standing water throughout the PRB that add mosquito habitat. Summer thunderstorms, that pool water for more than four days in hot weather, can result in Culex mosquito hatches. Other sources of water include; natural flows, livestock watering facilities, coal mining operations, and human outdoor water use and features in and around communities.

There is little evidence that treatment, either through the use of larvicides or malithion, on a site specific or basin-wide scale will have any effect on the overall spread of the disease; however, one study, conducted by Big Horn Environmental Consultants in 2008, showed that landscape level larvacide applications can decrease the number of hatching mosquitoes in an area.

4.7.8.5.3. Mitigation Measures

No additional mitigation measures are included.

4.7.8.5.4. Residual Effects

There are no mitigation measures proposed; residual would likely be the same as direct, indirect, and cumulative effects. If weather conditions are favorable for the Culex mosquito, an increase of WNv transmission can be expected. Mortality of susceptible species such as the Greater Sage-Grouse would increase.

4.7.9. Cultural Resources

4.7.9.1. Direct and Indirect Effects

BLM policy states that a decision maker's first choice should be avoidance of historic properties (BLM Manual 8140.06(C)). If historic properties cannot be avoided, mitigation measures must be applied to resolve the adverse effect. Non eligible site 48JO4264 will be impacted by the proposed project. No historic properties will be impacted by the proposed project. Following the 2006 State Protocol Between the Wyoming Bureau of Land Management State Director and The Wyoming State Historic Preservation Officer, Section VI(A)(1) the Bureau of Land Management electronically notified the Wyoming State Historic Preservation Officer (SHPO) on 11/12/14 that no historic properties exist within the area of potential effect (APE). If any cultural values (sites, features or artifacts) are observed during operation, they will be left intact and the Buffalo Field Manager notified. If human remains are noted, the procedures described in Appendix L of the PRB FEIS must be followed. Further discovery procedures are explained in Standard COA (General)(A)(1) and Appendix K of the Wyoming Protocol.

4.7.9.2. Cumulative Effects

Construction and development of oil and gas resources impacts cultural resources through ground disturbance, unauthorized collection, and visual intrusion of the setting of historic properties. Destruction of any archeological resource results in fewer opportunities to study of past human life-ways, to study changes in human behavior through time, or to interpret the past to the public. Additionally, these impacts may compromise the aspects of integrity that make a historic property eligible for the National Register of Historic Places. Recording and archiving basic information about archaeological sites and the potential for subsurface cultural materials in the proposed project area may serve to partially mitigate potential cumulative effects to cultural resources.

Fee actions constructed in support of federal actions can result in impacts to historic properties. Oil and gas development on split estate often includes construction of infrastructure that does not require permitting by BLM. Project applicants may integrate infrastructure associated with wells draining fee minerals with wells that require federal approval. BLM has no authority over fee actions, which can impact historic properties. BLM has the authority to modify or deny approval of federal undertakings on private surface, but that authority is limited to the extent of the federal approval. Historic properties on private surface belong to the surface owner and they are not obligated to preserve or protect them. The BLM may go to great lengths to protect a site on private surface from a federal undertaking, but the same site can be legally impacted by the landowner at any time. Archeological inventories reveal the location of sensitive sites and although the BLM is obligated to protect site location data, information can potentially get into the wrong hands resulting in unauthorized artifact collection or vandalism. BLM authorizations that result in new access can inadvertently lead to impacts to sites from increased visitation by the public.

4.7.9.3. Mitigation Measures

If any cultural values (sites, artifacts, human remains [Appendix L of the PRB FEIS]) are observed during operation of this lease/permit/right-of-way, they will be left intact and the BFO Manager notified. Further discovery procedures are explained in the PRB FEIS Standard COA (General)(A)(1). A temporary fence will be installed to protect contributing portions of eligible historic properties. The fence(s) will be installed (or the installation supervised) by a qualified archaeologist who meets or exceeds the qualification standards recommended by the Secretary of the Interior during construction in specific areas, as described in the site specific COA's.

4.7.9.4. Residual Effects

During the construction phase, there would be numerous crews working across the project area using heavy construction equipment without the presence of archeological monitors. Due to the extent of work and the surface disturbance caused by large vehicles, it is possible that unidentified cultural resources can be damaged by construction activities. The increased human presence associated with the construction phase also can lead to unauthorized collection of artifacts or vandalism of historic properties.

4.7.10. Recreation

4.7.10.1. Direct and Indirect Effects

CBNG development is changing the rural undeveloped nature of the Powder River Breaks to a rural industrial setting, decreasing the satisfaction levels of many hunters and other recreationists. Although access into the areas may be increased, development results in direct habitat loss and habitat fragmentation for big game effecting big game use.

Ongoing CBNG operations during the hunting season can impact hunting success and satisfaction, which may result in, decreased hunting activity in the area. However, hunting success has not been hampered thus far according to WGFD 2010 Annual Report.

Effects to recreation quality may occur depending on an individual's point of view. For those who prefer the solitude and natural setting, their recreation quality will be affected for the life of the project.

4.7.10.2. Cumulative Effects

The cumulative effects associated with Alternative B are within the analysis parameters and impacts described in the PRB FEIS and FCPA RMPA. For details on expected cumulative impacts, refer to the PRB FEIS, p. 4-328 and FCPA RMPA, p. 4-124.

4.7.10.3. Mitigation Measures

In order to prevent inadvertent trespass on to privately owned surface by the recreationalists, travel within the KDUE2 project area, on all private roads that would access Federal land, will be restricted to authorized company personnel serving in their official capacity.

4.7.10.4. Residual Effects

Effects to quality of the recreational experience may occur depending on an individual's point of view. For those who prefer the solitude and natural setting, the quality of the recreational experience may be reduced for the life of the project. The mitigation does nothing to minimize the effects to recreationists accessing public lands via public access or privately owned lands with landowner permission.

5. LIST OF PREPARERS (BFO unless otherwise noted)

Position/Organization	Name	Position/Organization	Name
NRS/Team Lead	Jim Verplancke	Archaeologist	Seth Lambert
Supr NRS	Casey Freise	Wildlife Biologist	Jim Verplancke
Petroleum Engineer	Will Robbie	Geologist	Kerry Aggen
Legal Assistant	Lois Jenkins	Assistant Field Manager	Bill Ostheimer
LIE	Sharon Soule	Supr NRS	Scott Jawors
Soil Scientist	Arnie Irwin	Acting Field Manager	Chris Durham
Assistant Field Manager	Clark Bennett	NEPA Coordinator	Tom Bills

6. REFERENCES AND AUTHORITIES

Baker, W. L. 2006. Fire and Restoration of Sagebrush Ecosystems. Wildlife Society Bulletin 34(1):177-185.

Bartos, T. T. and K. M. Muller Ogle. 2002. Water Quality and Environmental Isotopic Analyses of Ground-Water Samples Collected from the Wasatch and Fort Union Formations in Areas of Coalbed Methane Development – Implications to Recharge and Ground-Water Flow, Eastern Powder River Basin, Wyoming. U.S. Geological Survey, Water-Resources Investigations Report 02-4045, 2002.

Belnap, J., J. Kaltenecker, R. Rosentreter, J. Williams, S. Leonard, and D. Eldridge. 2001. Biological Soil Crusts: Ecology and Management. Technical Report 1730-2, United States Department of the Interior. 110 pp.

Big Horn Environmental (BHEC). 2012. Camp John Unit Special Management Area Phase 1 POD Wildlife Survey and Habitat Report. Prepared for Anadarko Oil and Gas Company, Inc. 14 pp.

BioTracking LLC. 2014. Fortification Elk Pregnancy Test Results; report O12914039. Moscow, ID.

BKS Environmental Consultants, Inc. 2012. Camp John SMA Year 2 POD (4-13-2012) Reclamation Plan: Supplemental Document to Camp John SMA Development Reclamation Plan. Prepared for Anadarko Petroleum Corpration.

Braun C. E. 1998. Sage-grouse declines in western North America: what are the problems? Proceedings of the Western Association of State Fish and Wildlife Agencies. 67:134–144.

Braun C. E., M. F. Baker, R. L. Eng, J. S. Gashwiler, and M. H. Schroeder. 1976. Conservation committee report on effects of alteration of sagebrush communities on the associated avifauna. Wilson Bulletin. 88:165–171.

Chadwick, C. 2011. CJU SMA 1.2 POD Engineered Road Designs Prepared for Anadarko Petroleum Corporation.

Chapman, S. S., S. A. Bryce, J. M. Omernik, D. G. Despain, J. ZumBerge, and M. Conrad. 2004. Ecoregions of Wyoming (color poster with map, descriptive text, summary tables, and photographs): U.S. Geological Survey (map scale 1:1,400,000). U.S. Geological Survey, Reston, Virginia.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines for management of sage grouse populations and habitats. Wildlife Society Bulletin 28:967-985.

Cooper, S. V., P. Lesica, and G. M. Kudray. 2007. Post-fire Recovery of Wyoming Big Sagebrush Shrub-steppe in Central and Southeast Montana. Report to the United States Department of the Interior, Bureau of Land Management, State Office. Montana Natural Heritage Program, Helena, Montana. 16 pp. plus appendices.

Ebert, J. I. and T. A. Kohler. 1988. The Theoretical Basis of Archeological Predictive Modeling and a Consideration of Appropriate Data-Collection Methods, in Quantifying the Present and Predicting the Past: Theory, Method, and Application of Archeological Predictive Modeling, edited by W. James Judge and Lynne Sebastian, pp 97-171. U.S. Department of the Interior, Bureau of Land Management Service Center, Denver, Colorado.

Eckerle, W. 2005. Experimental: Archeological Burial Model for Powder River and Tongue River Hydrological Basins, Wyoming. In Adaptive Management and Planning Models for Cultural Resource in Oil and Gas Fields in New Mexico and Wyoming, by Eric Ingbar, Lynne Sebastian, Jeffrey Altschul, Mary Hopkins, William Eckerle, Peggy Robinson, Judson Finley, Stephen A. Hall, William E. Hayden, Chris M. Rohe, Tim Seaman, Sasha Taddie, and Scott Thompson, pp. 39-102. Prepared for the Department of Energy, National Energy Technology Laboratory by Gnomon, Inc. Electronic document, http://www.gnomon.com/DOEPumpIII/FinalCombinedReport.pdf. Accessed August and September 2010.

Fahrig, L. and J. Paloheimo. 1988. Determinations of local population size in patchy habitats. Theoretical Population Biology 34:194-213.

Financial Forecast Center. 2011. Natural Gas Price: Henry Hub, LA. Internet website: http://www.forecasts.org/data/data/GASPRICE.htm. Accessed January 5, 2011.

Gelbard J. L. and J. Belnap. 2003. Roads as conduits for exotic plant invasions in a semiarid landscape. Conservation Biology. 17:420–432.

Grenier, M., B. Oakleaf, K. Taylor, and M. Hymas. 2004. Inventory and Mapping of Black tailed Prairie Dogs in Wyoming – An Estimate of Acreage Completion Report.

Griscom, H., Estes-Zumpf, W. and Keinath, D. 2008. Pre-drilling Surveys of Amphibian and Reptile Habitats in the Powder River Basin of Wyoming, Year One of Project Report. University of Wyoming.

Herman-Brunson, K. M., K. C. Jensen, N. W. Kaczor, C. C. Swanson, M. A. Rumble, and R. W. Klaver. 2009. Nesting ecology of greater sage-grouse *Centrocercus urophasianus* at the eastern edge of their historic range. Wildlife Biology 15:237-246.

Hillis, J. M., M. J. Thompson, J. E. Canfield, L. J. Lyon, and T. N. Lonner. 1991. Defining elk security: the Hillis paradigm. In Proceedings Elk Vulnerability Symposium, eds. A. G. Christensen, L. J. Lyon, and T. N. Lonner, 38-43. Bozeman: Montana State University.

Holloran, M J., B. J. Heath, A. G. Lyon, S. J. Slater, J. L. Kuppiers, and S. H. Anderson. 2005. Greater sage-grouse nesting habitat selection and success in Wyoming. J. Wildl. Manage. 69(2):638-649.

Holloran, M. J. 2005. Greater sage-grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming. PhD Dissertation. University of Wyoming. Laramie, Wyoming. 211 pp.

Ingelfinger F. 2001. The effects of natural gas development on sagebrush steppe passerines in Sublette County, Wyoming. M.Sc. thesis, University of Wyoming, Laramie, Wyoming.

Johnson, W. M. 1969. Life expectancy of a sagebrush control in central Wyoming. Journal of Range Management. 22: 177-182.

Klute, D. S., L.W. Ayers, M.T. Green, W.H. Howe, S.L. Jones, J.A. Shaffer, S.R. Sheffield, and T.S. Zimmerman. 2003. *Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States*. U.S. Department of the Interior; Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R6001-2003, Washington, D.C.

Knick, S. T. and J. T. Rotenberry. 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. Conservation Biology 9:1059-1071.

Knopf F. L. and J. R Rupert. 1995. Habits and habitats of Mountain Plovers in California. Condor 97:743-751.

Anadarko Oil and Gas, Incorporated (Anadarko). 2011. CJU SMA 1.2 CBNG POD, including the Master Multi-Point Surface Use and Operations Plan, Master Drilling Prognosis, Integrated Weed and Pest Management Plan, Water Management Plan, individual Applications for Permit to Drill, mapping, and other relevant information . Originally prepared in August 2005; subsequently revised with final revision March 2012. Anadarko Petroleum Corporation.

Love, J. D. and A. Coe Christiansen. 1985. Geologic Map of Wyoming: U.S. Geological Survey. Accessed at http://tin.er.usgs.gov/geoAnadarkoy/state/fips-unit.php?code=f56019 on July 27, 2010.

Lyon, A. G. and S. H. Anderson. 2003. Potential gas development impacts on sage-grouse nest initiation and movement. Wildlife Society Bulletin 31:486-491.

Lyon, L. J. and J. E. Canfield. 1991. Habitat selections by Rocky Mountain elk under hunting stress. Pages 99–105. in Christensen, A. G., L. J. Lyon, and T. N. Lonner, editors. Proceedings of the elk vulnerability symposium. Montana State University. Bozeman, USA.

Lyon, L. J., and A. G. Christensen. 1992. A partial glossary of elk management terms. U.S. Department of Agriculture, Forest Service, General Technical Report INT-GTR-288, Portland, Oregon.

McDonald, D., N.M. Korfanta, and S.J. Lantz. 2004. *The Burrowing Owl (Athene cunicularia): a technical conservation assessment*. USDA Forest Service, Rocky Mountain Region.

Meffe, G. K. and C. R. Carroll. 1994. Principles of Conservation Biology. Sinauer Associates, Inc. Sunderland, Massachusetts.

Miller, B. K., G. Ceballos, and R. P. Reading. 1994. "The Prairie Dog and Biotic Diversity." Conservation Biology 8(3):677-81.

Moynahan, B. J., M. S. Lindberg, J. J. Rotella, and J. W. Thomas. 2007. Factors affecting nest survival of greater sage-grouse in north-central Montana. Journal of Wildlife Management 71:1773-1783.

Naugle et al. In press.

Noss, R. F. and A. Cooperrider. 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity*. Defenders of Wildlife and Island Press, Washington, D.C.

Peckham, Erika. 2014. Personal Communication. Email forwarding Fortification elk survey results. Wildlife Biologist, Wyoming Game and Fish Department.

Peterson, D.A. 1990. Invertebrate communities of small streams in northeastern Wyoming. U.S. Geological Survey. Water-resources Investigations Report 85-4287.45 pp.

Porneluzi, P., J. C. Bednarz, L. J. Goodrich, N. Zawada, and J. Hoover. 1993. Reproductive performance of territorial Ovenbirds occupying forest fragments and a contiguous forest in Pennsylvania. Conservation Biology 7:618-622.

Primack, R. B. 1993. Essentials of conservation biology. Sinauer Associates, Sunderland, Massachusetts.

Robinson, S. K. 1992. Population dynamics of breeding birds in a fragmented Illinois landscape. Pages 408-418 in J. Hagan and D. W. Johnston, editors. Ecology and conservation of neotropical migrant land birds. Smithsonian Institution press, Washington, D.C.

Romin, L. A., and J. A. Muck. 1999. Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances. U.S. Fish and Wildlife Service, Salt Lake City, Utah. May 1999.

Rotenberry J. T. and J. A. Wiens. 1980a. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. Ecology. 61:1228–1250.

Rowland, M. M., M. J. Wisdom, L. H. Suring, and C. W. Meinke. 2006. Greater sage-grouse as an umbrella species for sagebrush-associated vertebrates. Biological Conservation 129:323-335.

Sawyer, H., Nielson, R., Strickland, D., and McDonald, L. 2005 Annual Report Sublette Mule Deer Study (Phase II): Long-term monitoring plan to assess potential impacts of energy development on mule deer in the Pinedale Anticline Project Area. 2005. Prepared for Wyoming Game and Fish Department.

Sawyer, H. and Nielson, R. Mule Deer Monitoring in the Pinedale Anticline Project Area: 2010 Annual Report. 2010. Prepared for Pinedale Anticline Planning Office (PAPO).

State Wildlife Agencies' Ad Hoc Committee for Sage-grouse and Oil and Gas Development. 2008. Using the best available science to coordinate conservation actions that benefit greater sage-grouse across states affected by oil and gas development in Management Zones I-II (Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming). Unpublished report. Colorado Division of Wildlife, Denver; Montana Fish, Wildlife and Parks, Helena; North Dakota Game and Fish Department, Bismarck; Utah Division of Wildlife Resources, Salt Lake City; Wyoming Game and Fish Department, Cheyenne.

Temple S. A. 1986. Predicting impacts of habitat fragmentation on forest birds: A comparison of two models. Pages 301-304 in Wildlife 2000 (J. Verner, C. J. Ralph, and M. L. Morrison, Eds.). Univ. Wisconsin Press, Madison.

Temple S. A. and J. R. Cary. 1988. Modeling dynamics of habitat-interior bird populations in fragmented landscapes Conserv. Biol.2 :340-347.

Temple, S. A. and B. A. Wilcox. 1986. Introduction: Predicting effects of habitat patchiness and fragmentation. In: Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates, ed. J. Verner, M. L. Morrison, and C. J. Ralph, 261-62. Madison: University of Wisconsin Press.

Thunderbird-Jones & Stokes. 2006.Anadarko Petroleum Corporation CJU SMA 1.2 Plan-of-Development Wildlife and Ute Ladies'-Trusses Habitat Assessment and Wildlife Surveys Prepared for Anadarko Petroleum Corporation.

Tirmenstein, D. 1999. *Artemisia tridentata* spp. *tridentata*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Internet website: http://www.fs.fed.us/database/feis/. Accessed August 11, 2010.

Turner, W. 2007. Survey of herpefauna in the Powder River Basin. Prepared by the Wyoming Game and Fish Department for the US Environmental Protection Agency.

United States Bureau of Labor Statistics (BLS). 2008. Fatal occupational injuries resulting from transportation incidents and homicides. http://www.bls.gov/iif/oshwc/cfoi/cftb0233.pdf. Website accessed January 5, 2010.

United States Bureau of Labor Statistics (BLS). 2009a. Fatal occupational injuries resulting from transportation incidents and homicides. http://www.bls.gov/iif/oshwc/cfoi/cftb0242.pdf. Website accessed January 5, 2010.

United States Bureau of Labor Statistics (BLS). 2009b. Occupational Injuries/Illnesses and Fatal Injuries Profiles. http://data.bls.gov:8080/GQT/servlet/ProfileYears. Website Accessed January 6, 2010.

United States Department of Agriculture, Natural Resources Conservation Service (USDA). 2010a. Soil Survey Geographic Database for North Cambell County Area and South Campbell County Area, Wyoming. Internet website: http://soildatamart.nrcs.usda.gov and http://websoilsurvey.nrcs. usda.gov/app/ websoilsurvey.aspx. Accessed D 2010.

United States Department of Agriculture, Natural Resources Conservation Service (USDA). 2010b. National Soil Survey Handbook, title 430-VI. Internet website: http://soils.usda.gov/technical/handbook/ Accessed December 20, 2010.

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook. 296pp.

United States Department of Agriculture, Natural Resources Conservation Service (NRCS). 1998. Soil Quality-Agronomy Technical Note #7.

United States Department of Agriculture, Soil Conservation Service, Soil Survey Division Staff (USDA). 1993. Soil survey manual. U.S. Department of Agriculture Handbook 18.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2013. Fortification Creek Planning Area Annual Monitoring Report: 2013. Buffalo Field Office.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2012. Fortification Creek Planning Area Annual Monitoring Report: 2012. Buffalo Field Office.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2011a. Fortification Creek Planning Area Proposed Resource Management Pan Amendment/Environmental Assessment. Buffalo Field Office. WY-070-EA08-135. March 2011.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2011. Internal shapefiles and wildlife tracking tables. Data received and prepared March, 2011.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2010a. Personal communication with Bonnie Heidel, Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming. Referenced in BLM EA # WY-070-10-121.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2010b. Greater sage-grouse lek locations and raptor nest database. Buffalo, Wyoming, Field Office. Accessed July 2010.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2010c. Williams Draw Unit Gamma and Williams Draw Unit Delta PODs Environmental Assessment. EA #WY-070-08-042. Buffalo, Wyoming Field Office.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2009. *Final Mineral Occurrences and Development Potential Report*. Buffalo Field Office. June 19, 2009.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2006. Cumulative Effects Analysis (An Evaluation) Fortification Creek Area of Special Management Consideration. Buffalo, Wyoming, Field Office.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2005. Task 2 report for the Powder River Basin Coal review past and present and reasonably foreseeable development activities. Prepared by ENSR Corporation, Fort Collins, Colorado, for the BLM Casper Field Office. Internet website: http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/prbdocs/coalreview/Task2.html.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2004. Instruction Memorandum No. WY-2005-057: Statement of Policy Regarding Sage-Grouse Management Definitions, and Use of Protective Stipulations, and Conditions of Approval. Wyoming State Office, Cheyenne, Wyoming.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2003a. Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project (PRB FEIS). EIS # WY-070-02-065. Wyoming State Office, Cheyenne, Wyoming. January, 2003.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2003b. Record of Decision and Resource Management Plan Amendments for the Powder River Basin Oil and Gas Project (PRB ROD). #WY-070-02-065. Wyoming State Office, Cheyenne, Wyoming. April 30, 2003.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 2001. Approved Resource Management Plan for Public Lands Administered by the Buffalo, Wyoming, Field Office. April 2001.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 1990. Instruction Memorandum No. WY-90-564: Resource Management Plan Action and Wyoming BLM Standard Mitigation Guidelines for Surface-disturbing Activities. Wyoming.

United States Department of the Interior, Bureau of Land Management (USDI BLM). 1985. Buffalo Resource Management Plan for Buffalo Resource Area. Buffalo, Wyoming, Field Office. October 1985.

United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS). 2011. National Wetland Inventory data. Internet website: http://www.fws.gov/wetlands/Data/Mapper.html

United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS). 2010. Endangered and Threatened Wildlife and Plants: 12-month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened and Endangered. March 4, 2010.

United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS). 2002a. Mountain Plover Survey Guidelines. U.S. Fish and Wildlife Service. March 2002. 6 pp.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2002b. Final Biological and Conference Opinion for the Powder River Oil and Gas Project, Campbell, Converse, Johnson, and Sheridan Counties (WY6633). U.S. Fish and Wildlife Service. December 17, 2002. Cheyenne, WY. 58pp.

United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS). 2000. Endangered and Threatened Wildlife and Plants; 12-Month Finding for a Petition To List the Black-Tailed Prairie Dog as Threatened. Federal Register 64(24):5476-5488. February 4, 2000.

United State Geological Survey (USGS), EROS Data Center. http://seamless.usgs.gov/. Last updated December 28, 2010.

Urban, D. L. and H. H. Shugart, Jr. 1984. Avian demography in mosaic landscapes: modeling paradigm and preliminary results. Pages 273-280 in J. Verner, M. L. Morrison, and C. J. Ralph editors. Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison.

Walker, B. L., D. E. Naugle, and K. E. Doherty. 2007. Greater sage-grouse population response to energy development and habitat loss. Journal of Wildlife Management 71:2644-2654.

Whitehead, R. L. 1996. Groundwater Atlas of the United States, Montana, North Dakota, South Dakota, Wyoming. USGS Hydrologic Atlas (HA) 730-I. Internet website: http://pubs.usgs.gov/ha/ha730/ch_i/index.html. Accessed July 25, 2010.

Wyoming Department of Agriculture. 2010. Weed and Pest Declared List (by County) Amended February 2010. Internet website: http://www.wyoweed.org/Documents/DocumentPage/2010%20Declared%20List.pdf Accessed August 2010.

Wyoming Department of Environmental Quality (WDEQ). 2005. Water Quality Rules and Regulations. Chapter 8, Quality Standards for Wyoming Groundwaters. Ground Water Section, Wyoming Department of Environmental Quality, Cheyenne, Wyoming.

Wyoming Game and Fish Department (WGFD). 2012. Wyoming Game and Fish Department Annual Report. http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/JCR_BGSHER_ELK_20120004513.pdf

Wyoming Game and Fish Department (WGFD). 2011. Wyoming Game and Fish Department Annual Report. http://wgfd.wyo.gov/web2011/Departments/WGFD/pdfs/WGFDANNUALREPORT_20110001745.pdf

Wyoming Game and Fish Department (WGFD). 2010a. Correspondence between J. Emmerich (WGFD Deputy Director) and D. Spencer (BLM). Letter dated April 27, 2010.

Wyoming Game and Fish Department (WGFD). 2010b. Sheridan Region Annual Big Game Herd Unit Reports 2009. pgs 299-320. http://gf.state.wy.us/wildlife/biggamejcr2009/index.asp

Wyoming Game and Fish Department (WGFD). 2010c. Recommendations for Development of Oil and Gas Resources Within Important Wildlife Habitats. April 2010.

Wyoming Game and Fish Department (WGFD). 2009a. Correspondence between J. Emmerich (WGFD Deputy Director) and D. Spencer (BLM). Letter dated April 27, 2010.

Wyoming Game and Fish Department (WGFD). 2009b. Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats. Version 4.0. Revised November 2009.

Wyoming Game and Fish Department (WGFD). 2008. Hunting and Sage-Grouse: A Technical Review of Harvest Management on a Species of Concern in Wyoming. Wyoming Game and Fish Department. Green River, Wyoming. 21pp.

Wyoming Game and Fish Department (WGFD). 2005. A Comprehensive Wildlife Strategy for Wyoming. Wyoming Game and Fish Department, Cheyenne, Wyoming. July 12, 2005.

Wyoming Game and Fish Department (WGFD). 2004. A Rocky Mountain Elk Habitat Conservation Plan for the WGFD Sheridan Region (And Portions of the Cody Region). Wyoming Game and Fish Department. Sheridan Region.62 pp.

Wyoming Oil and Gas Conservation Commission (WOGCC). 2011. Actual CBNG Produced Water for the Powder River Basin. Internet website: http://Wogcc.state.wy.us. Accessed May 2011.