ENVIRONMENTAL ASSESSMENT

COPPER RIDGE SHALLOW GAS
EXPLORATION AND DEVELOPMENT PROJECT

Prepared for

Bureau of Land Management
Rock Springs Field Office
Rock Springs, Wyoming

Prepared by

This Environmental Analysis was prepared by *Gary Holsan Environmental Planning*, an environmental consulting firm, with the guidance, participation, and independent evaluation of the Bureau of Land Management (BLM). The BLM, in accordance with Federal regulation 40 CFR 1506.5(a) and (b), is in agreement with the findings of the analysis and approves and takes responsibility for the scope and content of this document.

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ABBREVIATIONS/ACRONYMS

AADT	average annual daily traffic
ac	acres
ac-ft	acre feet
ac-ft/mi^2/yr	acre feet per square mile per year
ac-ft/yr	acre feet per year
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
AML	Appropriate Management Level
Anadarko	Anadarko Petroleum Corporation
analysis area	Copper Ridge Project Area
ANC	Acid Neutralizing Capacity
AO	authorized officer
APD	Application for Permit to Drill
AQD	Air Quality Division
AQRV	Air Quality Related Values
ARM	Ambient Ratio Method
ASTM	American Society for Testing Materials
AUM	Animal Unit Month
BA	Biological Assessment
BACT	Best Available Control Technology
BBCC	Black Butte Coal Company
bbl	barrel = 42 gallons
BLM	Bureau of Land Management
BTEX	Benzene, toluene, ethylbenzene, xylene
BWPD	barrel of water per day
CASTNet	Clean Air Status and Trends Network
CBM	Coal Bed Methane
CDPHE-APCD	Colorado Department of Public Health and Environment, Air Pollution Control Division
CD/WII	Continental Divide/ Wamsutter II
CEQ	Council for Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGF	Central gathering facility
CIA	cumulative impacts analysis
cm	centimeter
CO	carbon monoxide
COE	Corps of Engineers
CREG	Consensus Revenue Estimating Group
CRPA	Copper Ridge Project Area
CRU	Copper Ridge Unit
CWA	Clean Water Act
CWYL	Crucial Winter/Yearlong
dBA	decibel, A-weighted scale
DEIS	Draft EIS
DEQ	Department of Environmental Quality
dia.	Diameter
DOI	US Department of Interior
dv	deciview
EA	environmental assessment
EIS	Environmental Impact Statement

ABBREVIATIONS/ACRONYMS

EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
F	Fahrenheit
FAA	USDT Federal Aviation Administration
FEMA	Federal Emergency Management Act
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FLPMA	Federal Land Policy and Management Act
FR	Federal Register
Frac	Fracture Stimulation
FS	Forest Service
ft	foot (or feet)
FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
GAP	Wyoming Gap Analysis Program
g/hp-hr	grams per horsepower-hour
GLO	General Land Office
gpd	gallons per day
gpm	gallons per minute
GPS	Global Positioning System
GRRA	Green River Resource Area (now RSFO Area)
GRRMP	Green River Resource Management Plan
HAP	Hazardous Air Pollutants
HDPE	High density polyethylene
HMA	herd management area
HNO_3	nitric acid
hp	horsepower
H_2S	hydrogen sulfide
HWA	Hayden-Wing Associates
I-80	Interstate 80
IAA	Impact Analysis Area
ID	interdisciplinary
IDT	interdisciplinary team
IMPROVE	Interagency Monitoring of PROtected Visual Environments
in	inches
kg	kilograms
kg/ha	kilograms per hectare
km	kilometer
LAC	level of acceptable change
LOP	Life of Project
m	meter
MCF	thousand cubic feet
mcfd	thousand cubic feed per day
mcfgpd	thousand cubic feet of gas per day
mg/l	milligrams per liter
mm	millimeter
MLE	Most Likely Exposure
MMCFD	million cubic feet per day
mph	miles per hour
MSDS	Material Safety Data Sheet
MSHA	Mine Saftey Hazard Administration
N_2	Nitrogen
NA	not applicable

ABBREVIATIONS/ACRONYMS

NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
n.d.	no date
NEPA	National Environmental Policy Act
NEIC	National Economic Information Center
NH_4	Ammonia
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
NO_3^-	nitrate
NOS	Notice of Staking
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSI	no significant impacts
NSR	New Source Review
NTL	Notice to Lessee
NTU	Nephelometric Turbidity Unit
NWS	National Weather Service
NWI	National Wetlands Inventory
O_3	ozone
OSHA	Occupational Safety and Health Administration
P&A'd	plugged and abandoned
PA	Proposed Action
PC	progressive cavity
pH	acidity measurement unit (negative logarithm of the hydrogen ion [H^+] concentration)
PEMC	Palustrine, emergent, seasonally flooded
PFO	Pinedale Field Office
PI	Petroleum Information, Inc.
PIC	Planning Information Corporation
$PM_{2.5}$	particulate matter less than 2.5 microns in effective diameter
PM_{10}	particulate matter less than 10 microns in effective diameter
POD	Plan of Development
PSD	Prevention of Significant Deterioration
PPP	pollution prevention plan
PUBFx	Palustrine, unconsolidated bottom, semi-permanently flooded, excavated
PUP	Pesticide Use Proposal
PUSAh	Palustrine, unconsolidated shore, temporarily flooded, diked/impounded,
PUSCh	Palustrine, unconsolidated shore, seasonally flooded, diked/impounded
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RFFAs	reasonably foreseeable future actions
RFD	reasonably foreseeable development
RFO	Rawlins Field Office
RMP	Resource Management Plan
RMOGA	Rocky Mountain Oil & Gas Association
ROD	Record of Decision
ROW	Right-of-Way
RSGA	Rock Springs Grazing Association
RSFO	Rock Springs Field Office
RV	recreational vehicle
SAR	Sodium Absorption Ratio

ABBREVIATIONS/ACRONYMS

SARA	Superfund Amendments and Reauthorization Act
scf	standard cubic feet
SCS	Soil Conservation Service
SCEMA	Sweetwater County Emergency Management Agency
SEO	Wyoming State Engineer's Office
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SOW	State of Wyoming
SPCC	Spill Prevention Control and Countermeasures
SSF	spring summer fall
SWPPP	storm water pollution prevention plan
TCF	trillion cubic feet
TDS	total dissolved solids
Thalweg	The line defining the lowest points along the length of a river bed or valley
TPQ	threshold planning quantity
TSS	Total Suspended Solids
UAD	unquantified additional development
UGMA	upland game management area
UND	Undetermined
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
US DOE EIA	US Department of Energy Energy Information Administration
USFS	US Forest Service
USGS	United States Geological Survey
UW	University of Wyoming
VOC	Volatile Organic Compounds
VRM	Visual Resource Management
w/	with
w/i	within
w/o	without
WAAQS	Wyoming Ambient Air Quality Standards
WAS	Western Archaeological Services
WDAI	Wyoming Department of Administration and Information
WDE	Wyoming Department of Employment
WDEQ-AQD	Wyoming Department of Environmental Quality, Air Quality Division
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Commission
WOS	Wildlife Observation System
WQD	Water Quality Division
WRDS	Wyoming Water Resources Data System
WSGS	Wyoming State Geological Survey
WTA	Wyoming Taxpayers Association
WYDOT	Wyoming Department of Transportation
WYGISC	Wyoming Geographic Information Science Center
WYL	Winter/Yearlong
WYNDD	Wyoming Natural Diversity Database
WYO 430	Wyoming Highway 430
YBP	years before present
YRL	Yearlong
$\mu eq/l$	microequivalents per liter
$\mu g/m^3$	micrograms per cubic meter
^oF	degrees Fahrenheit
Δ	difference (delta)

CHAPTER 1

PURPOSE AND NEED

1.0 INTRODUCTION, PURPOSE, AND NEED FOR ACTION

Anadarko E&P Company LP (Anadarko) has notified the Bureau of Land Management (BLM), Rock Springs Field Office that Anadarko proposes to explore and potentially develop a shallow gas project located within the administrative boundary of the BLM's Rock Springs Field Office. The proposed Copper Ridge Shallow Gas project area (CRPA) is generally located in Townships 16 and 17 North, and Ranges 100 through 101 West, 6th Principal Meridian, Sweetwater County, Wyoming, as shown on Figure 1-1. The shallow gas wells, access roads, pipelines, and other ancillary facilities located on federal land would be permitted with the BLM and the Wyoming Oil and Gas Conservation Commission (WOGCC). Facilities located on State of Wyoming and privately owned surface would be permitted with the WOGCC.

Exploration and production of federal oil and gas leases by private industry is an integral part of the BLM's oil and gas policy. The BLM oil and gas program encourages development of domestic oil and gas reserves, as expressed in a variety of laws passed by Congress. Natural gas development is an integral part of the United States' energy future, and part of our current national energy policy. Production of reliable domestic natural gas will strengthen the United States' energy future by decreasing the reliance on foreign supplies.

The purpose and need for the proposed natural gas exploration and development project is to exercise the lease holders' rights within the project area to drill, complete, and operate additional natural gas wells, subject to applicable laws and stipulations of the lease. Exploration and production of natural gas, including methane gas from coal-bearing formations, is in accordance with the President's National Energy Policy, Executive Order 13212. The policy calls for federal agencies "to develop a national energy policy designed to help the private sector, and, as necessary and appropriate, State and local governments, promote dependable, affordable, and environmentally sound production and distribution of energy for the future." Natural gas is an integral part of the U.S. energy future due to its availability, the presence of an existing market delivery infrastructure, and the environmental advantages of clean-burning natural gas.

The purpose and need for this project is to allow the private land/mineral owner and federal lease holder (same) the opportunity to drill and test shallow gas within the project area. The Proposed Action would allow for the exercise the leaseholders' existing rights to drill for, extract, remove, and market gas products if exploration proves successful. Ancillary facilities needed to allow for drilling, extraction, and production of natural gas are also proposed. National mineral leasing policies and the regulations by which they are enforced recognize the statutory right of lease holders to develop federal mineral resources to meet continuing needs and economic demands so long as undue and unnecessary environmental degradation is not incurred. Private land owners have the right to develop their holdings in accordance with state and local laws.

CHAPTER 1: PURPOSE AND NEED

1.1 PROJECT DESCRIPTION

Access to the CRPA is provided by the two-lane paved U.S. Highway 430, Sweetwater County Road No. 4-26, and an existing road network in the CRPA developed to service prior and on-going drilling and production activities. The CRPA overlies an area already developed by two existing oil and gas projects; the Brady Field and the Jackknife Spring Field. Drilling operations within the Brady and the Jackknife Spring fields began in 1960 and the resulting production continues today. Since 1960, a total of 59 producing wells have been drilled and developed. Eight additional, non-producing wells have been plugged, abandoned, and reclaimed.

Anadarko proposes drilling a maximum of 89 wells on 160 acre spacing, and utilize much of the existing infrastructure and surface facilities, including access roads, drill pads, and pipeline corridors for the Copper Ridge project. Drilling is expected to last for approximately two to four years, with a projected life-of-project (LOP) of 15 to 20 years. Wells would target sandstone reservoirs and coal seams within the Almond Formation at depths of 2,000 to 4,500 feet. Gas produced would be from both coal seams (coal bed methane or CBM) and adjacent sands.
In addition to wellpads and associated construction, Anadarko anticipates that additional infrastructure such as access roads, compression and pipelines would be necessary to develop this resource. Additional gas volumes would be transported via existing trunk pipelines, but additional gathering pipelines are anticipated, depending on the drilling success. The Proposed Action is discussed in-depth in Chapter 2, Proposed Action and Alternatives

The CRPA is located within the checkerboard land pattern that resulted from early railroad grants made by the federal government to the Union Pacific Railroad Company. The odd-numbered sections within the project area are privately owned (surface and mineral rights). Anadarko recently purchased the private surface within the checkerboard from Union Pacific Railroad Company. As a result, Anadarko owns the majority of the private surface and mineral estate within the CRPA. Total land areas and status are shown in Table 1-1.

Table 1-1. Surface Ownership of the Copper Ridge Project Area.

Surface Ownership	Acres	Percent
Federal (BLM)	11,565	46.4
Private	12,108	48.5
State of Wyoming	1,280	5.1
Total	**24,953**	**100.0**

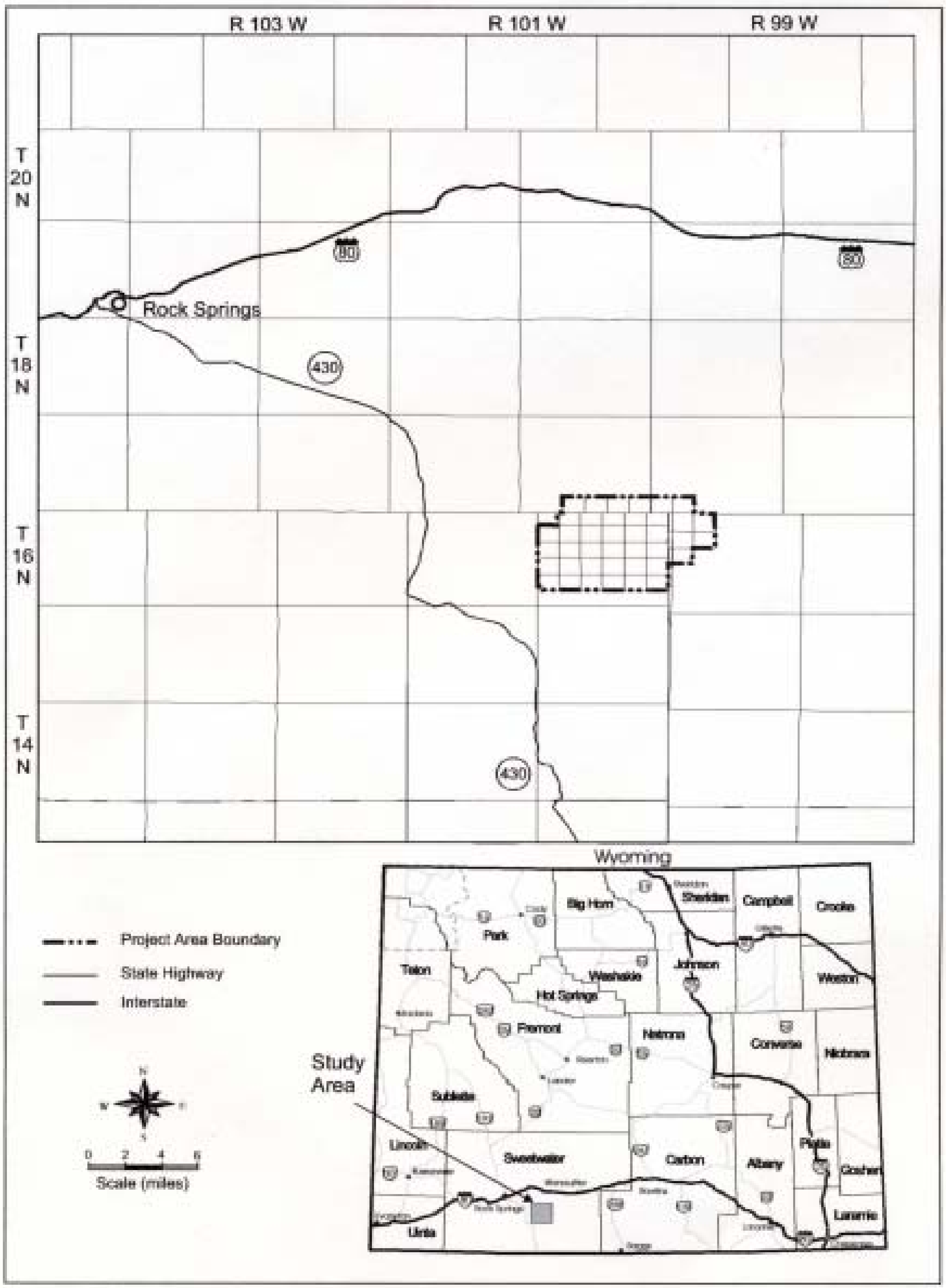


Figure 1-1. General Location Map, Copper Ridge Shallow Gas Project, Sweetwater County, Wyoming

1.2 RELATIONSHIP TO EXISTING PLANS AND DOCUMENTS

Resource Management Plan - The document which directs management of federal lands within the Rock Springs Field Office is the approved Resource Management Plan (RMP) for the Green River Resource Area (now the RSFO -USDI-BLM 1997). The objective for management of oil and gas resources, as stated in the RMP, is to provide for leasing, exploration, and development of oil and gas while protecting other resource values. In addition, the RMP states public lands within the checkerboard area are open to mineral leasing and development (to promote mineral recovery) with appropriate mitigation on a case-by-case basis.

The development of natural gas within the Copper Ridge Unit is in conformance with the RMP. The reasonably foreseeable development analyzed in the RMP assumed 1,258 successful well completions under the proposed plan. As of September 2003, the RSFO has between 696 and 705 producing wells including 26 producing CBM wells (per preliminary review of raw data from WOGCC). The Proposed Action is within that analyzed under the GRRMP. The environmental analysis prepared for the proposed additional wells in the Copper Ridge Unit would incorporate decisions, terms, and conditions of use as described in the RMP. This analysis incorporates and tiers to the air quality analysis prepared for the Pinedale Anticline Natural Gas Project EIS (USDI, 2000) which updated the air quality analysis for the Kemmerer, Pinedale, and Rock Springs Field Offices' RMPs.

Other Environmental Documents – Continental Divide/Wamsutter II (CD/WII) EIS/ROD (USDI, 1998) includes all or a portion of the CRPA in its Cumulative Impacts Analysis Area (CIAA). The Pinedale Anticline EIS/ROD (USDI, 2000), CD/WII EIS/ROD (USDI, 1998), and Desolation Flats DEIS (USDI, 2003) include the CRPA for air impacts analysis only. The Decision Record, Finding of No Significant Impact, Changes to Modification/Corrections to the Environmental Assessment for the Vermillion Basin Natural Gas Exploration and Development Project (USDI, 2002), Appendix D which analyzed directional and horizontal drilling techniques in the Almond formation. Appendix D can be access via the internet at http://www.wy.blm.gov/nepa/rsfodocs/vermbasin/VBPA-well-architecture-letter.pdf

Use Authorizations - Use authorizations (i.e., rights-of -way, permits, etc.) for roads, powerlines, pipelines, compressors, and well site facilities would be processed through the BLM application for Permit to Drill (APD) and Sundry Notice permitting process as long as the facilities remain on-lease and are owned and operated by the unit operator. Any sales pipeline located on-lease or any facility located off-lease would require individual rights-of-way. All individual permits located on public land would be subject to further environmental review.

Lease Stipulations - Some federal oil and gas leases within the proposed area may include special stipulations on occupancy. These stipulations are in addition to the standard lease terms and are designed to protect surface resources such as soils, water, and wildlife by restricting periods of activity or areas of disturbance. Application of these lease stipulations would be handled on a case-by-case basis for each APD submitted to the BLM.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT

The proposed project has been analyzed in accordance with the requirements of the National Environmental Policy Act (NEPA). To comply with NEPA and the Council on Environmental

Quality regulations, which implement NEPA, the BLM is required to prepare an environmental analysis. This environmental assessment (EA) serves several purposes.

- It provides the public and government agencies with information about the potential environmental consequences of the project and alternatives;
- identifies all practicable means to avoid or minimize environmental harm from the project and alternatives;
- It provides the responsible official with information upon which to make an informed decision regarding the project.

NEPA requires Federal agencies to use a systematic, interdisciplinary approach to ensure the integrated use of natural and social sciences in planning and decision making. Factors considered during the environmental analysis process regarding the Anadarko project include the following:

- A determination of whether the proposal and alternatives are in conformance with BLM policies, regulations, and approved resource management plan direction.
- A determination of whether the proposal and alternatives are in conformance with policies and regulations of other agencies likely associated with the project.

This EA is not a decision document. It documents the process used to analyze the potential impacts of the proposed action and alternatives and discloses the effects of the proposed action and alternatives to that action. A Decision Record (DR), signed by the responsible official (Field Manager, Bureau of Land Management, Rock Springs Field Office) will document the final decision regarding the selected alternative. The BLM will document whether or not significant impacts would occur with implementation of any of the alternatives. If the BLM determines that no significant impacts would occur, a Finding of No Significant Impact (FONSI) Decision Record would be issued. If significant impacts are identified, the BLM decision would be to complete an Environmental Impact Statement (EIS), with subsequent public input and additional analysis of the alternatives. The BLM decision will relate to BLM administered lands.

1.4 LAND AND RESOURCE MANAGEMENT ISSUES AND CONCERNS

In accordance with NEPA and CEQ regulations 40 CFR 1501.7, an early and open process for determining the scope of issues to be addressed is required and for identifying the significant issues related to a proposal. In compliance with this procedural requirement, the BLM, RSFO released a scoping notice on October 15, 2002 for a 30-day review period. Sixteen comment letters were received. The scoping process led to the identification of the following land and resource management issues and concerns potentially associated with the Proposed Action:

- Potential increased traffic and associated impacts on existing county, state, and BLM roads.
- Potential socio-economic impacts to local communities.

- Potential impacts to surface and groundwater resources, including sedimentation/salinity to the Colorado River system and CBM produced water quality issues.
- Potential impacts to sensitive soils within the project area.
- Potential impacts from emissions resulting from additional drilling and production activities.
- Potential impacts related to reclamation of disturbed areas and control of noxious weed invasions.
- Potential conflicts with livestock management operations in the analysis area, including possible impacts to range improvement projects.
- Potential impacts to cultural and historical values within the analysis area.
- Potential impacts to wildlife habitats, especially habitat fragmentation, within the analysis area, including big game, greater sage grouse, and raptors.
- Potential impacts to the Salt Wells Wild Horse Herd Management Area and wild horses.
- Potential impacts to listed, or proposed for listing, threatened and endangered plant and animal species, including potential Colorado River depletion and effects on downstream listed fish species.
- Potential cumulative effects of drilling and development activities when combined with other ongoing and proposed developments on lands adjacent to the Copper Ridge project area.
- Potential conflicts between mineral development activities and recreational opportunities.
- Application and acquisition of appropriate permits.

Certain issues were determined to not be "significant issues related to the proposed action" (40 CFR 1501.7) because they are not potentially affected or impacted by the proposal. These issues brought forth during public scoping and reasons for eliminating that issue from consideration in the analysis are shown below:

- Issues brought forth pertaining to fracing methods and chemical components of drilling fluids do not warrant specific consideration since fracing methods as well as drilling fluids must be in compliance with Federal and state requirements.

- Subsidence: Although it is possible for subsidence to occur, experience in the RSFO has shown subsidence is only likely to occur when material (i.e., coal, trona) is extracted. Extraction of coal is not proposed for this action and only partial dewatering of the coal seam is necessary for the gas to desorb. The coal seam is located over 2,000 feet deep and the integrity of the formations above (i.e., sandstone) would preclude any subsidence from occurring at the surface.

- Migration of natural gas to the surface: The targeted natural gas reservoir is confined, and fractures or other structures that would allow the gas to move from the formation are not present. The layered overburden includes sandstone, siltstones and of shale. Migration of gas to the surface is extremely unlikely. Large quantities of gas would need to migrate through more than 2,000 feet of layered rock to reach the surface, an extremely unlikely occurrence. Migration is further prohibited by well completion processes, designed and implemented to prevent the loss of the resource being produced. The area between the boreholes and casing will be cemented from surface to total depth, preventing the gas from migrating other than through the production pipe.

1.5 AUTHORIZING ACTIONS

The proposed federal, state, county, and local actions required to implement the Copper Ridge Shallow Gas Project are listed in Table 1-2.

Table 1-2. Federal, State, and County Authorizing Actions.

AGENCY	NATURE OF ACTION
DEPARTMENT OF THE INTERIOR	
Bureau of Land Management (Rock Springs Field Office)	NEPA compliance and approval of ROW applications for pipelines; temporary use permits; approval of APD's and Sundry Notices.
U.S. Fish and Wildlife Service	Coordination, consultation, and impact review on federally listed or proposed for listing, threatened or endangered species of fish, wildlife, and plants. Migratory bird impact coordination.
U.S. ENVIRONMENTAL PROTECTION AGENCY	
	Spill Prevention Control and Countermeasures (SPCC) Plans. Regulate hazardous waste treatment, storage, and /or disposal.
DEPARTMENT OF THE ARMY	
U.S. Army Corps of Engineers	Issue permits(s) (Section 404) for placement of dredged or fill material in or excavation of waters of the U.S. and their adjacent wetlands.

AGENCY	NATURE OF ACTION
WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY	
Water Quality Division	National Pollution Discharge Elimination System (NPDES) permits for discharging waste water and storm water runoff. Conformance with all surface water standards; permit to construct and permit to operate. Permits to construct settling ponds and waste water systems, including ground water injection and disposal wells. Regulate disposal of drilling fluids from abandoned reserve pits. Administrative approval for discharge of hydrostatic test water.
Air Quality Division	New Source Review (NSR) Permit: All pollution emission sources, including compressor engines and portable diesel and gas generators.
WYOMING STATE ENGINEERS OFFICE	
	Issue permits to appropriate groundwater and surface water. Issue temporary water rights for construction permits to appropriate surface water.
WYOMING STATE HISTORIC PRESERVATION OFFICE	
	Consultation concerning identification, evaluation, assessments effect and treatment of adverse effects on historic properties.

AGENCY	NATURE OF ACTION
SWEETWATER COUNTY	
	Zoning certificates for site development and construction. Small wastewater system permits, where applicable. Road use agreements and/or oversize trip permits when traffic on county roads exceeds established size and weight limits or where the potential for excessive road damage exists. Construction and conditional use permits for all new structures. Zoning changes where applicable. Control of noxious weeds. Permits to bore or trench county roads or for any crossing or access off a county road.
WYOMING DEPARTMENT OF TRANSPORTATION	
	Conformance with applicable size and weight limits for trucks.
WYOMING OIL AND GAS CONSERVATION COMMISSION	
	Primary authority for drilling on state and privately held mineral resources and secondary authority for drilling on federal lands. Authority to allow or prohibit flaring or venting of gas on private or state owned minerals Regulate drilling and plugging of wells operating on private or state owned minerals. Aquifer Exemption Permit. Directional drilling. Rules and regulations governing drilling units. Gas injection well permits.

CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

2.0 PROPOSED ACTION

Anadarko E&P Company LP (Anadarko) proposes drilling, completing, and operating a maximum of 89 shallow gas wells and related production and water disposal facilities in the Copper Ridge Project Area (CRPA)(Figure 2-1). This analysis assumes that all wells would be drilled and produced although it is possible a lesser number of wells could actually be drilled and produced. If initial drilling attempts are unsuccessful or uneconomical, the possibly exists that Anadarko would abandon the proposal.

Anadarko is proposing to drill 89 shallow gas wells for both technical and economic reasons. Off the 89 wells, 41 would be located on public lands managed by the BLM, 46 would be located on private lands owned by Anadarko, and one well would be located on State of Wyoming lands. The 89 wells were determined by Anadarko to be the minimum number necessary to implement this project to provide; (1) adequate surface area and geological coverage, (2) flexibility in the exploration program due to uncertainty in reservoir characteristics, and (3) an appropriate number of wells to evaluate project viability in a timely fashion. The proposed well count permits an examination of reservoir and geological properties as well as characteristics that allow for production from a depth range of 2,000' to 4,500'. Additionally, 89 wells provides flexibility in repositioning a pod or group of wells in the event that the initial drilling attempts encounter poor quality reservoir or indicate a need to drill future wells on denser spacing. Also, the 89-well proposal provides sufficient wells to effectively dewater the target reservoirs.

The CRPA is located in an existing oil and gas production area, which includes both the Brady Field and the Jackknife Spring Field. Since 1960, a total of 59 producing wells have been drilled and developed, and eight additional, non-producing wells have been plugged, abandoned, and reclaimed within these two existing fields. Natural gas production from these two fields totals approximately 579.4 billion cubic feet since 1978, according to WOGCC records. Wells in the Brady Deep, Brady Shallow, and Jackknife Spring Fields range in depth from approximately 6,000 feet to 17,000 feet, targeting many formations (Almond, Anderson coal, Blair, Dakota, Entrada, Ericson, Frontier, Mesaverde, Muddy, Nugget, Phosphoria, and Weber). The shallow gas wells being proposed with the Copper Ridge project would target sandstone reservoirs and coal seams within the Almond Formation at depths of 2,000 to 4,500 feet. Gas produced would be from both coal seams (coal bed methane or CBM) and adjacent sands.

2.1 PLAN OF OPERATIONS

2.1.1 Preconstruction Planning and Site Layout

Anadarko would follow the procedures outlined below to gain approval for the proposed activity on public lands managed by the BLM within the CRPA. Development activities proposed on private and State of Wyoming surface would be approved by the WOGCC. The WOGCC permitting procedures require filing an APD with the WOGCC and obtaining a ROW from the surface owner.

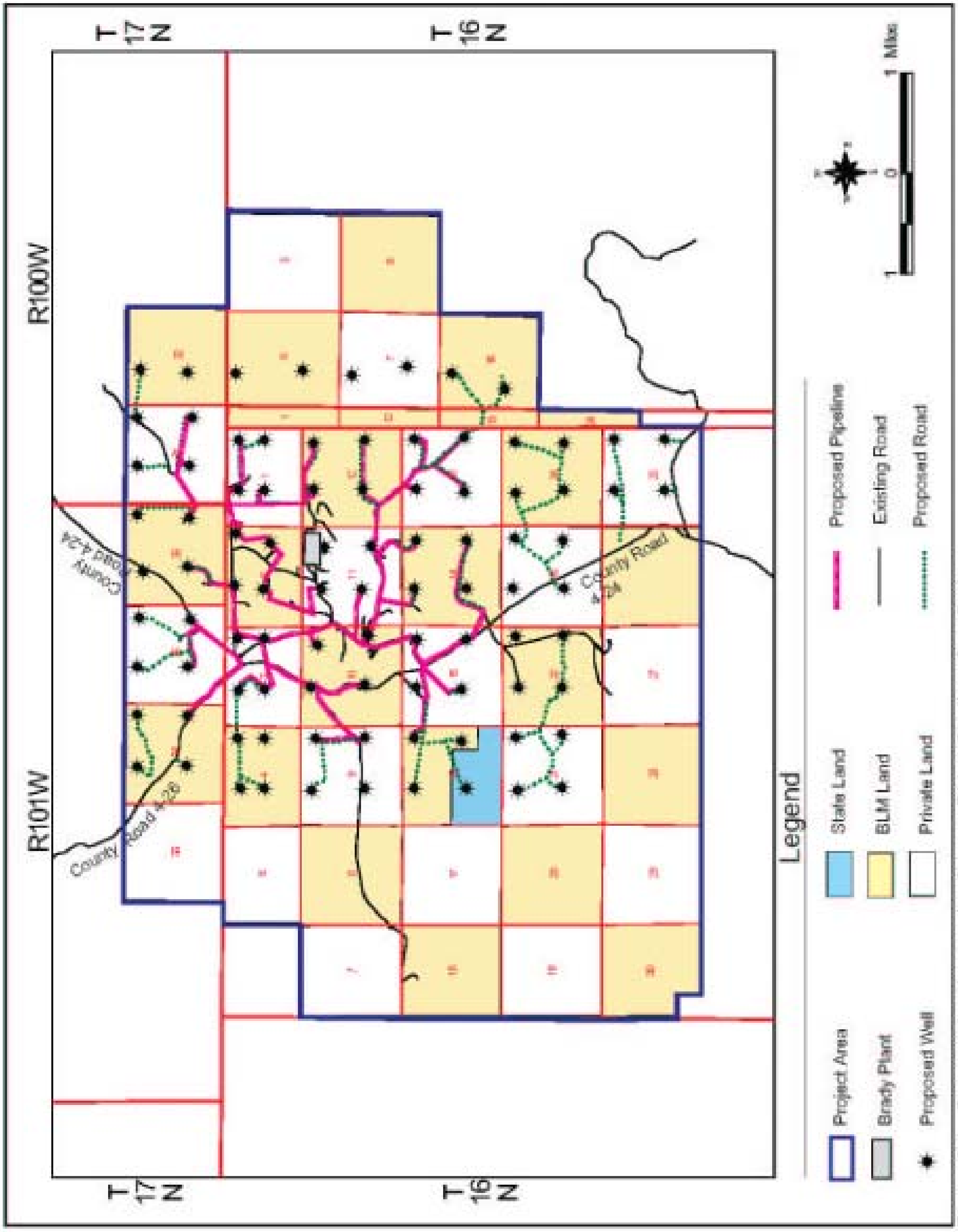


Figure 2-1. Proposed action on the Copper Ridge Shallow Gas Project.

- Prior to the start of construction activities, Anadarko would submit a Notice of Staking (NOS), APD, or ROW application to the BLM with a map showing the specific location of the proposed activity. Anadarko, BLM, and the affected surface lessees or owners would conduct an on-site evaluation during which site specific requirements would be identified and discussed. Following the on-site evaluation, Anadarko would file the application which would include site-specific construction plans where necessary to describe the proposed development.

- The proposed facility would be staked by Anadarko and inspected by representatives of the BLM to ensure consistency with plans in the APD/Sundry Notice/ROW Application. Should discrepancies in the application be found, Anadarko would revise the application as necessary. The BLM would then grant an authorization with the appropriate Conditions of Approval. The applicant then has one year within which to commence the proposed activity.
- Prior to approval, Anadarko must have cleared the proposed construction area for cultural values, special status plants and animals, paleontological values, nesting raptors, sage grouse, etc. If any of these resources are found, appropriate mitigation would be applied.

Following is a discussion of proposed construction, drilling, production, and reclamation techniques proposed by Anadarko.

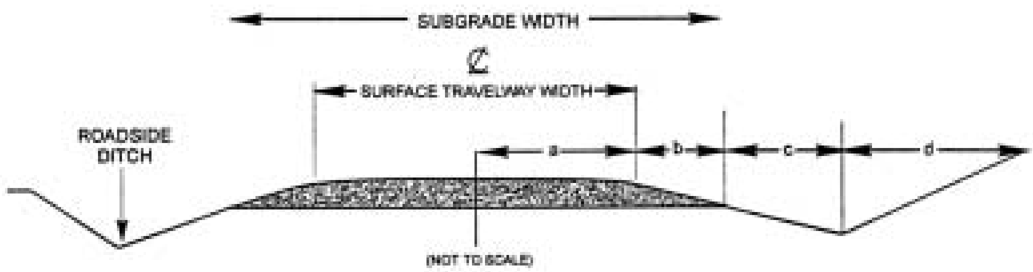
2.1.2 Construction and Drilling Phase

2.1.2.1 Road Construction

Development of the 89 wells would require the construction/reconstruction of approximately 22.25 miles of access roads and approximately 66.75 miles of gas and produced water gathering lines (facilities corridors). An estimated 10.25 mi of new road would be built on federal land and 12.0 miles of road/facilities corridors would be built on private and state land.

All new access roads within the CRPA would be constructed for the specific purpose of natural gas field development. Roads would be located to minimize disturbances and maximize transportation efficiency. The operators propose to construct access roads across public lands to wells in accordance with BLM Manual 9113 standards. New access roads would be designed and constructed to resource road standards to facilitate reclamation should the well be a dry hole. Roads located on private lands would be constructed in accordance with standards imposed by the private land owner. The number of roads would be limited to decrease potential impacts by accessing wells from short resource roads off the local roads. Roads would be closed and reclaimed by the operators when they are no longer required for production operations, unless otherwise directed by the BLM or private landowners. Roads would be designed to minimize disturbance and would be built and maintained as specified by the BLM to provide safe operating conditions at all times. Surface disturbance would be contained within the road ROW.

Where feasible, gas and water gathering lines would be buried in a single trench adjacent to (with a minimum 5-foot offset) the access road travelway. The average travel surface width for gravel-surfaced resource roads would be 16 feet with turnouts as necessary. Figure 2-2 shows a typical cross section with width specifications. All surface disturbance would be contained



	Minimum Subgrade Width (ft.)	Minimum Surfaced Travelway Width (ft)	a (ft)	b (ft)	c (ft)	d (ft)	Approximate Disturbance Width (ft)	Total ROW Width (ft)	Design Speed (mph)
Resource Road	16	14	7	2	4	8	40	50	15-30
Local Road	24	20	10	2	4	8	46	55	20-50
Collector Road	28	24	12	2	4	8	52	60	30-50

DIAGRAM OF TYPICAL TURNOUTS ON RESOURCE ROADS (PLAN VIEW)

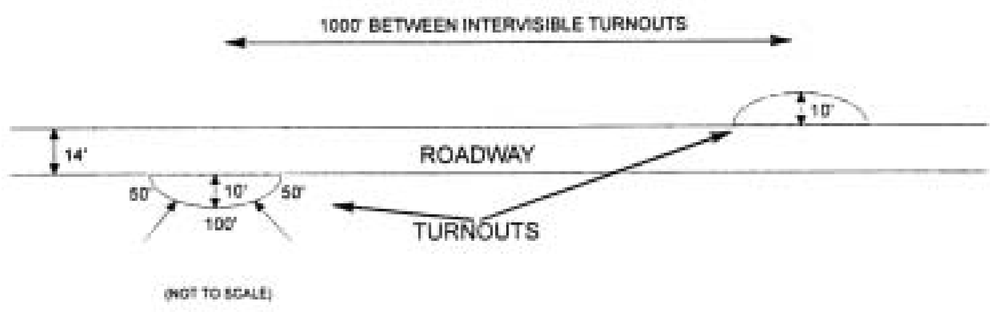


Figure 2-2. Typical Roadway Cross-Section with Width Specifications.

within authorized ROWs. Because roads and gathering lines would be constructed within a single corridor, a corridor 60 feet wide would be disturbed during construction.

Well pad and access road construction would require a maximum of four workers for a period of approximately 4 days per location. These workers would include both heavy equipment operators engaged in road and well pad construction and truck drivers hauling heavy equipment to and from locations. Construction workers would likely be hired locally and contracted by Anadarko or its agents.

Topsoil on new road ROWs would be salvaged, stored in elongated piles within road ROWs, and seeded to prevent erosion as necessary. Available topsoil (up to 12 inches) would be stripped from all road corridors prior to commencement of construction activities, would be stockpiled, and would be redistributed and reseeded on backslope areas of the borrow ditch after completion of road construction activities. Borrow ditches would be reseeded in the first appropriate season after initial disturbance. If a well were determined to be unproductive, the entire road ROW would be recontoured and reclaimed as soon as practical using stockpiled topsoil and appropriate seeding techniques. Any large rocks that occurred on the ROW prior to construction would be scattered over the ROW after reseeding. Disturbance areas associated with the Proposed Action and alternatives are summarized in Table 2-1.

Table 2-1. Types and Approximate Acreage of Surface Disturbance on Federal Land – Proposed Action.

Proposed Action									
	Estimated Life-of-Project (LOP) Disturbance Area (acres)					Estimated Initial Disturbance Area (acres)			
Type of Disturbance	Federal	Private	State	Total		Federal	Private	State	Total
Number of Wells	41	46	2	89		41	46	2	89
Well Pads[1]	41	46	2	89		82	92	4	178
Roads[2]	37.27	41.81	1.8	80.88		74.54	83.62	3.6	161.82
Compressor[5]	0.0	0.9	0.0	0.9		0.0	0.9	0.0	0.9
Pipelines[3,4]	0.0	0.0	0.0	0.0		111.81	125.45	5.45	242.71
Total	**78.27**	**88.71**	**3.8**	**170.78**		**268.35**	**301.97**	**13.05**	**583.37**

[1]Assumes initial disturbance of approximately 2 acres for each well pad and LOP disturbance of 1 acre per well pad.
[2]Assumes an average of 0.25 mi of new roads with parallel gas gathering and water discharge lines (60-ft average disturbance width) for each well. All disturbance except for the estimated 30-ft wide road travelway and adjacent ditches would be reclaimed for the LOP.
[3]Assumes an average of 0.75 mi of new gas gathering and water discharge lines per well of which approximately 0.50 mi will be constructed within existing pipeline corridors.
[4]Assumes an average disturbance width of 30 ft.
[5] The compressor station (about 0.9 acres of disturbance) would be located on private land.

2.1.2.2 Well Pad Design and Construction

Major components of each well pad include a level area for placement/support of the drilling rig and other equipment and an earthen reserve pit to contain drilling fluids. The entire well pad would be cleared of vegetation, and up to 12 inches of topsoil would be removed from all areas of cut, fill, and/or subsoil storage. After topsoil has been removed, the pad would be graded using standard earth-moving equipment (e.g., dozers, scrapers) to prepare a level working surface. Each well location would be designed so that the amount of cut-and-fill material would roughly balance, where feasible, thereby minimizing the need to stockpile excess subsoil adjacent to the well location until site reclamation.

The reserve pit would be excavated using a dozer or other appropriate equipment. Materials excavated from the reserve pit would be stockpiled adjacent to the pit and used to backfill the pit during reclamation. Depending upon the depth to groundwater, the quality of groundwater produced during drilling, and soil permeability, reserve pits may be lined with an impermeable liner as needed to control seepage. (Lining of reserve pits will be determined on a case-by-case basis during the APD process). The reserve pit would be fenced to protect livestock and wildlife until the pit is reclaimed. Reserve pit fluids would be allowed to dry by evaporation for approximately one year prior to reserve pit closure and drill site reclamation. When the pit is backfilled, cuttings and drilling muds would be covered to a depth of at least three feet.

The level area of the wellpad required for initial drilling and completion operations would be approximately 360 x 240 ft, including a reserve pit approximately 100 feet by 50 feet and 10 feet deep, so average surface disturbance would be about 2 acres/well. The assumption for this EA is that the well pad disturbance area would be all new, which is the worst case scenario. Should new wells be located on existing well pads, the total disturbance would be less than that analyzed. A typical drill site layout is shown on Figure 2-3.

Erosion control would be implemented, as necessary, at each well location through prompt revegetation of disturbed areas and by constructing surface water drainage controls such as berms, diversion ditches, sediment ponds, and silt fences in accordance with the approved reclamation and Storm Water Pollution Prevention Plans (SWPPPs). All diversion ditches and other surface water and erosion control structures at each location would be shown on maps provided with each APD. SWPPPs would be prepared for all well locations, access roads, and other disturbances of more than 5 acres, as required by the WDEQ.

Following construction of the well pad and access road for a given well, a rotary drilling rig would be transported via truck to the well pad and erected on-site. Approximately 15 days would be required to drill, log, and case each well using a conventional rotary drill rig and associated rig equipment. Wells would be drilled to sandstone reservoirs and coal seams within the Almond Formation at depths of approximately 2,000-4,500 feet. The Almond formation is presently proposed for initial exploration, but other sandstone and coal reservoirs may be explored. Cuttings and all drilling fluids would be contained in the reserve pit, and drilling fluids would be recovered and re-used whenever practical. The reserve pit would be lined as needed to prevent loss of drilling fluids through seepage. If necessary, the reserve pit would first receive a layer of bedding material (e.g., clay, sand) sufficient to prevent contact between the liner and any exposed rocks. The reserve pit would be fenced to protect livestock and wildlife until the pit is reclaimed.

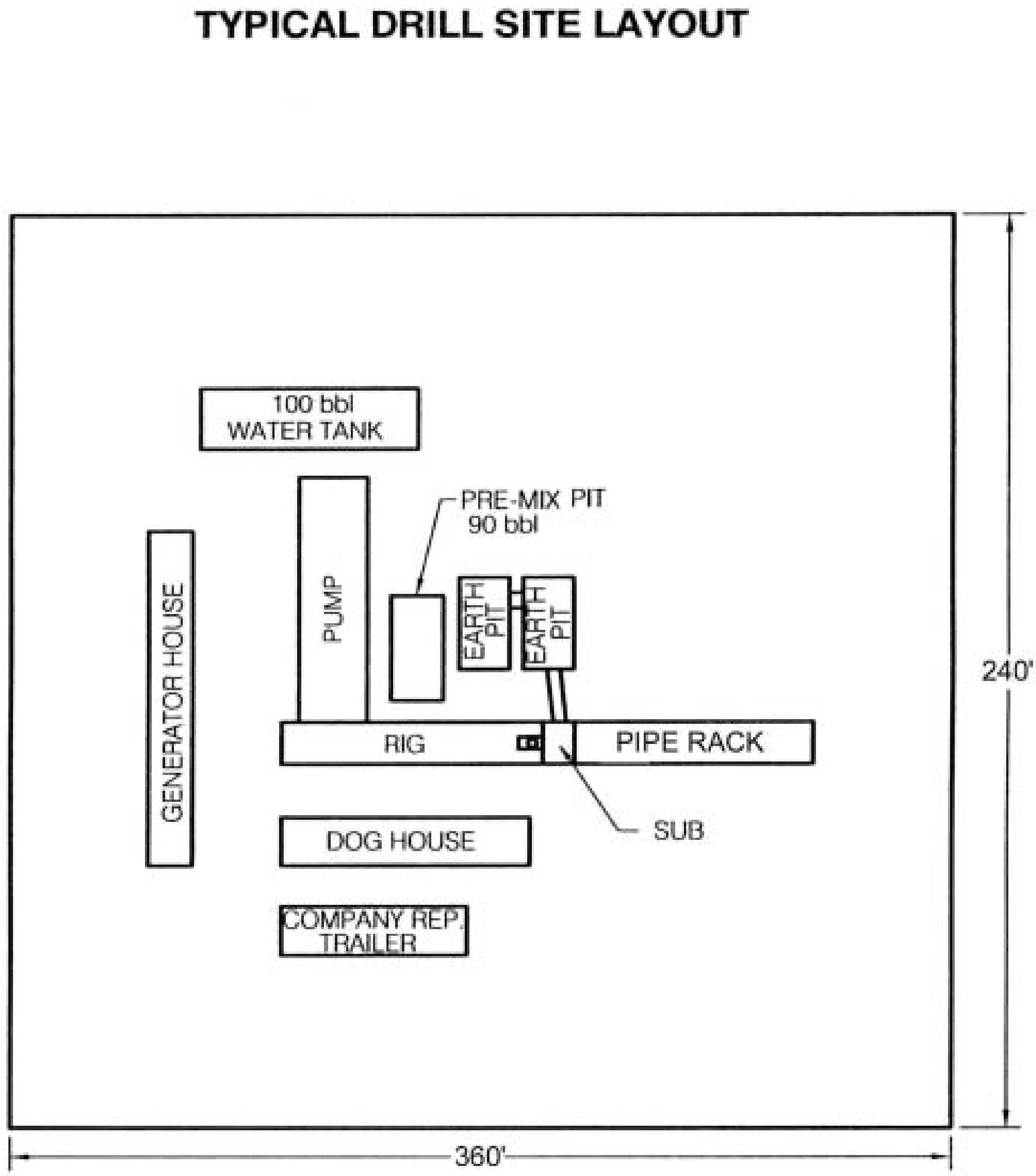


Figure 2-3. Typical Drill Site Layout – Copper Ridge Shallow Gas Project.

2.1.2.3 Drilling Operations

In the event that undesirable materials (e.g., hydrocarbon liquids) are inadvertently discharged to a reserve pit, they would be removed immediately and disposed of in accordance with WDEQ requirements. If any oil in the pit (as evidenced by sheen on the water surface) is not immediately removed, the pit would be protected to prevent waterfowl use as directed by the BLM.

Approximately 6,000 barrels (bbl) (252,000 gallons) of water would be required to drill each well. For the proposed action, a total of 534,000 bbl (22,428,000 gallons) or 68.8 acre-ft would be required for drilling, assuming no re-use of drilling water. This water would be obtained from the water supply well in the NE1/4SE1/4, Section 10 T10N, R101W (Nightingale Well No. 1). Water used to drill one well also may be reused for drilling subsequent wells to conserve water.

No abnormal temperatures, pressures, or hydrogen sulfide levels are anticipated to be encountered during drilling. Any shallow water zones encountered would be reported and adequately protected.

Drilling rigs would be contracted by Anadarko from third parties. The drill rig would be rated at approximately 1,200 horsepower, supplied by on site diesel powered generators. The drill rig contractor would typically employ four workers per 12-hour shift, with one crew on shift and one crew off. These crews would reside at their own homes or other living quarters in nearby towns (e.g., Rock Springs). A number of additional personnel may be required to be on location during various stages of the drilling operation, including a geologist, a mud logger, and other service personnel. In some cases, these individuals would be required to remain on location 24 hours a day during drilling operations, and trailers would be provided on-site for their use.

If any spills of oil, gas, or other noxious fluids occur, Anadarko would immediately contact the BLM and any other regulatory agencies as necessary, and cleanup efforts would be initiated. These actions would occur at any stage of drilling, completion, operation, or abandonment of facilities.

During drilling and subsequent operations, all equipment and vehicles would be confined to access roads, well locations, and other areas specified in approved APDs, except in emergency situations.

Fresh-water aquifers and potentially minable coal blocks would be protected by running casing - steel pipe - into the open borehole and cementing the casing into place. Cementing would also isolate all other formations in the hole and would effectively eliminate the possibility of contamination between hydrocarbon zones and/or water aquifers and other mineral resources.

2.1.3 Completion and Production Testing Phase

In accordance with 43 C.F.R. 3164, a Well Completion Report would be filed with the BLM no later than 30 days after well completion. Following wellbore casing and cementing, potentially productive coal seams and sandstone reservoirs of the Almond Formation would be perforated and tested. During preparation for production testing, the rig used to drill the well would be replaced with a smaller service rig that would operate only during daylight hours. Smaller diameter (2-7/8-inch or 2-3/8-inch) tubing would be placed in the cased hole and pumping equipment set below the perforated intervals. If the completed interval is incapable of flowing naturally, water would be pumped from the completed zone using sucker rod pumping units, progressive cavity pumps, or submersible pumps, until natural gas flow is established. Each pump would require approximately 20 horsepower, initially to be supplied by on site generation, replaced with utility electric power within one year. This procedure may require 560 days or more of pumping to initiate diagnostic gas flow rates.

Pursuant to WOGCC regulations and/or BLM Notice to Lessee (NTL) 4A, gas flows would be measured at the surface, and noncommercial volumes of gas would be temporarily flared or vented under controlled conditions at the well site. Anadarko expects to flare or vent a maximum of 50 MCF of gas per 5 days for each well. Venting would be conducted in accordance with WOGCC regulations. Once the permitted venting limit is reached, wells would either be put into production or shut-in for later production. Produced water would flow through gathering lines buried below frostlines to the existing water disposal wells. Each well likely would be production tested for an estimated 6 to 18 months to evaluate the commercial feasibility of further development. Routine daily maintenance, including pump changes, would be required during the evaluation period.

Based on the results of this initial production test, the coals and sandstone reservoirs may be further studied by petroleum engineers to determine if gas flow rates may be augmented through hydraulic fracture stimulation ("a frac"). A frac is designed to improve gas or fluid movement from the reservoir to the wellbore ("permeability"). In the course of a frac, fresh water or other water-based fluids are pumped down the wellbore and through the casing perforations under sufficiently high pressure to physically fracture the formation rock. Sand grains or other similar proppants are carried in suspension in fluids into the fractures. Following stimulation, the wellhead is opened at the surface and frac fluid flows back into the wellbore and is discharged at the surface into the reserve pit. Successfully fractured formations will close on the proppants, leaving open channels for gas and liquid to be produced to the wellbore. Excess frac fluid would be evaporated or removed from the site for disposal at an authorized location. Wells may be fractured without proppant.

Within 365 days after termination of drilling and completion activities, the liquid contents of the reserve pit, if any, would be removed and disposed of at an approved waste disposal facility. If adverse weather conditions prevent removal of the fluids from the reserve pit within 365 days, an extension may be granted by the BLM. If necessary, under special circumstances, reserve pit contents would be removed and disposed of at an appropriate facility and in a manner that satisfies all relevant state and federal regulations and stipulations. The reserve pit would be reclaimed by filling it with the spoil removed during initial pit construction, spreading previously stored topsoil, and reseeding according to BLM or surface owner specifications. After reclamation of disturbed areas no longer needed for production, each producing location typically would occupy an area of approximately 1 acre. Reserve pit back-filling and reseeding would not occur until after production testing, since the pit is generally used to hold liquids during such operations.

Production testing would, on average, require two workers for 90-540 days for every 30 wells. Existing Brady Unit personnel would be utilized where possible. Telemetry would be utilized in an effort to minimize the number of visits to and the time spent at the wellsite.

2.1.4 Pipeline Construction

Gas collection lines for in-field gas collection (gathering system) would be installed to bring natural gas from individual well sites to the Central Gathering Facility (CGF) and the interconnect pipeline. Gas collection lines would generally be located adjacent to roads or access road travelways (with a 5-foot minimum offset), where feasible, and all necessary authorizing actions for the lines would be addressed prior to installation. A total of approximately 242.71 mi of gas and water collection lines would be installed within the 60-ft wide facilities corridor.

Sufficient topsoil to facilitate reclamation would be removed from collection line ROWs and stockpiled before construction; however, ROWs that do not require major excavation may be stripped of vegetation to ground level (scalped) by mechanical cutting, leaving topsoil intact and root masses relatively undisturbed. Scalping, coupled with ripping of compacted soils, would facilitate vegetation re-establishment.

A trench approximately 6-feet deep would be excavated with a trencher or backhoe. Up to 12-inch diameter HDPE conduit would be buried at depths of 3.0-4.5 feet, except at major road and railroad crossings, where the depth would be at least 6 feet. Spoil and topsoil would be windrowed separately.

2.1.5 Anadarko Gas Compression

If the pilot project proves successful, a natural gas compression facility may be constructed within the exploration area, located in the NW1/4 NW1/4 of Section 11, Township 16 North, Range 101 West, on private lands. Wellsite compression may also be utilized to move gas. Anadarko plans to install a 600 HP compressor during the pilot portion of the project, and up to 4,800 HP at full development. Approximately 20% of this compression horsepower will be electric utility powered, with the remainder being natural gas engine driven. Natural gas from the exploration area would be delivered to the compressor station via gas gathering lines. Once the natural gas reaches the compressor station, dehydration units would remove residual water from the gas, and this water would be evaporated from the dehydration unit.

2.1.6 Natural Gas Production

Initial natural gas production from individual wells is expected to vary significantly and depend upon the presence or absence of contributing coalbed and sandstone reservoirs. Production is expected to be from coal beds and surrounding sands. To facilitate the removal of water from wells with substantial contribution from coal seams, some well site production facilities would be installed once wells have been completed. In accordance with applicable regulations, a facilities/site security diagram would be filed with the BLM within 30 days of installation. The operator would adhere to all site security regulations as specified in Onshore Oil and Gas Order No. 3.

Rod-type pumping units or submersible pumps (powered by gas-driven engines, propane generators, or gas-powered generators fueled by produced gas) would be used to remove water from any wells incapable of natural flow. In some wells, produced water and gas would be separated at the wellhead. Other wells would not require separators, as the water and gas would separate in the well casing. No uncontained surface discharge is proposed. Water produced during initial production operations would be disposed of in the existing water disposal wells. Water would be delivered from each well to the water disposal wells. Produced water quality would be monitored in accordance with state and federal regulations. Pumping units may be enclosed by a small shelter to avoid damage from wind, snow, and cold weather.

If the exploration field is economically productive, a centrally located, natural gas-fired compressor (e.g., 600 horsepower [hp] initially, up to 4,800 hp at full production) would be installed on private land. Exploratory wells on adjacent private land have been successful, so gas compression would likely be needed to transport the gas to market. Gas volumes would dictate the amount of compression required. Gas exiting the wellbore would be transported from each well through the natural gas gathering system to the compression station.

Anadarko anticipates production of up to 300 thousand cubic feet of gas per day (mcfgpd) from each well, which may require well site compressors. On-location compressors would be located and muffled to minimize noise and would comply with all applicable WDEQ, Air Quality Division (AQD) permitting requirements, as necessary. Anadarko would evaluate on-location compression needs as the project develops.

Electric-powered compression is proposed as part of the exploration project. Anadarko estimates that 20% of the compression for the project would be powered by electricity from a utility. In addition, wellsite electrical requirements would be supplied by the utility.

All wells would be operated in a safe manner according to standard industry operating procedures. Routine maintenance of the producing wells would be necessary to maximize performance and to detect operational difficulties. Each well site would be monitored daily to ensure operations are proceeding safely and efficiently. This visit would include, but would not be limited to, checking gauges, valves, fittings, and other on-site facilities. Routine on-site equipment maintenance would also be performed as necessary. All roads and well sites would be regularly inspected and maintained (e.g., regraded, resurfaced, watered) to minimize dust and erosion and to assure safe operations.

Production operations would occur year-round, requiring the use of access roads in the project area on a year-round basis. Access roads would be maintained as necessary by gravelling in spring or fall and plowing snow during winter months.

Producing well workovers are periodically necessary to correct downhole problems in a producing well to return the well to production. Workovers are implemented on an as-needed basis and are undertaken to increase or maintain production from the current downhole producing zone; to recomplete in a new zone; to lower operating costs by reducing water and/or sand production; or to return the well to its production objective by pulling and replacing leaking tubing or pulling and repairing lift equipment. Workovers normally take 1 to 4 days.

Ancillary facilities would include access roads, gas and water gathering lines, a power source, a central gathering/metering facility (CGF), and, if the field proves economically viable, a compressor station. No new power lines are currently proposed. Anadarko proposes to use existing above ground power lines in conjunction with buried electrical distribution lines, as needed.

Each well would require gas and water gathering lines to transport product to a centralized facility to be located on private land and water lines to transport produced water to a central disposal facility and a power source. A trunk line gas gathering system will be constructed utilizing high-density polyethylene [HDPE]) starting with 4-inch at the wellhead and graduating up to 12-inch at the compressor inlet. A network of water lines (up to 8-inch diameter HDPE) would be required to collect produced water. Water would be conveyed to a water transfer station and on to a salt water disposal facility. Gas and water lines would be installed adjacent to access road ROWs. Temporary power would be supplied by gas-driven engines, propane generators, or gas-powered generators fueled by produced gas until commercial power is made available.

2.1.7 Estimated Employment Requirements.

Existing Anadarko employees would be utilized for gas field development and operation over the LOP. Additional workers would be used for surveying, engineering, maintenance, inspection, and other specialty services. Construction workers would be hired from the local work force when available; otherwise, workers from outside the area would be hired.

2.1.8 Water Supply and Disposal

Water for drilling wells would come from produced water from existing wells. Water used to drill one well would be re-used to drill subsequent wells where practical.

Because of geological factors, gas may be contained in both sandstone and coalbed reservoirs within the Almond Formation. Completion of gas-charged sandstone reservoirs is expected to result in the immediate production of natural gas. In contrast to coalbed methane performance, conventional wells are anticipated to flow under their own energy and would not require artificial lift equipment. Conventional production of natural gas is driven by the creation of a pressure drop between the reservoir and the wellbore which initiates and maintains the flow of gas. Expected initial gas and water flow rates from wells of this type are 500 Mcfd and 5 Bwpd respectively.

In the case of methane within coal beds, more than 90% of methane stored in coal is adsorbed onto coal surfaces or absorbed within the coal (Jones and DeBruin 1990). The Cretaceous coals of the western Washakie Basin are water-bearing, and desorption of methane gas occurs when the formation hydrostatic pressure is reduced by pumping water out of the coalbed through a wellbore. As hydrostatic pressure drops, the physical bond between carbon (coal) and methane molecules is broken, and methane bubbles form and flow in a water solution towards the zone of lower pressure at the wellbore. Therefore, to create favorable conditions for the release of methane gas, water must be produced prior to and during methane extraction, especially during initial coalbed dewatering. Anadarko would file for the appropriation of the water rights for all produced waters, and dewatering permits would be obtained from the Wyoming State Engineers Office.

Based on limited data from the seven of the nine wells completed on private land, the maximum initial water discharge rate from each well would be about 500 barrels per day (bpd) The water discharge rate per well is expected to decrease to about 75 bpd during the first 18 months of pumping. Actual discharge values may be greater or less depending on geologic conditions, pumping equipment limitations, interference of adjacent wells, and reservoir enhancement methods.

Pumping equipment used for the dewatering phase of the proposed project would be the same type generally used by the petroleum industry to lift oil and/or water (i.e., rod-type pumping units and/or electric submersible [downhole] pumps). Anadarko would likely use downhole progressive cavity (pc) pumps, which employ a mechanical drivehead, sucker rods inside a tubing string, and an engine powered by an electric generator, diesel, propane, or produced natural gas. These units would be selectively employed within the CRPA and likely would be gasoline- or propane-powered during the early phases of development.

A 20 hp progressive cavity (pc) type pumping unit will most likely be used, which is capable of pumping a daily maximum rate of about 600 bpd (25,200 gal/day). The pc-type pumps may be replaced by submersible or beam pumps at some well sites as water production rates decline.

Produced water would be disposed of in existing WDEQ/WQD approved permitted water disposal wells after transport through buried water pipelines. Produced water pipelines generally would be located between natural gas pipelines and roads within the 60-ft wide facilities corridor. No produced water would be stored or discharged in open surface facilities such as ponds, impoundments, or streams at any time during development or production.

2.1.9 Ancillary Facilities

Anadarko would construct ancillary facilities as necessary to meet production needs. Such facilities may include, but not be limited to (1) produced water disposal equipment, (2) individual well site compression, (3) individual well site liquids recovery units, (4) electrical power lines, (5) gas metering stations, (6) pipeline pigging facilities, (7) field storage buildings, and (8) cathodic protection facilities. The number and location of such ancillary facilities is unknown at this time, but most would be installed within the boundaries of existing disturbances.

2.1.10 Site Restoration and Abandonment

Reclamation would be conducted on all disturbed public lands in compliance with the BLM Wyoming Policy on Reclamation (BLM 1990b). The short-term goal of the reclamation program is to stabilize disturbed areas as soon as possible after disturbance to protect sites and adjacent undisturbed areas from degradation. The long-term goal is to return the land to conditions approximating those that existed prior to disturbance.

Reclamation would occur during two phases of the proposed project. Initially, well pads and facilities corridors would be partially reclaimed after well testing and production/ancillary facilities are installed. This initial reclamation would reduce the amount of disturbed area to only that necessary for production operations. Final reclamation at the end of the LOP would involve reclamation of all remaining disturbed areas. In addition, all unproductive well sites and the ROWS to these sites would be reclaimed as soon as practical during the LOP.

2.1.10.1 Initial Reclamation

After installation of production equipment, the well pad needed for a producing well would be reduced from approximately 2 acres to approximately 1 acre. Drilling and other fluids contained in reserve pits would be evaporated and covered in place as authorized by the BLM and/or WOGCC. If necessary, the material would be removed from pits and disposed of at an authorized location outside of the CRPA (e.g., existing lined evaporation ponds or injector wells). The unused portion of the pad would be recontoured and reseeded within 1 year.

The following procedures are proposed by Anadarko to assure that all disturbed areas are stabilized and that revegetation efforts are enhanced so that significant impacts do not occur (BLM-RSFO 1997, BLM-PFO 1999b).

Scarification. Prior to reseeding, all compacted areas would be scarified by ripping or chiseling to loosen compacted soils. Scarification promotes water infiltration, better soil aeration and root penetration. Scarification would be done when soils are dry to promote shattering of compacted soil layers.

Seedbed Preparation. Appropriate seed bed preparation is critical for seed establishment. Seedbed preparation would be conducted immediately prior to seeding to prepare a firm seedbed conducive to proper seed placement and moisture retention. Seedbed preparation would also be performed to break up surface crusts and to eliminate weeds that may have developed between final grading and seeding. In most cases, chiseling is sufficient because it leaves a surface smooth enough to accommodate a tractor-drawn drill seeder and rough enough to catch broadcast seed and trap moisture and runoff. In low to moderate saline soils, a firm, weed-free seedbed is recommended. With high salinity levels, particularly when a high water table is involved, a fallow condition may not provide the best seedbed. If existing vegetation and weeds are chemically eradicated, the remaining dessicated roots and stems improve moisture infiltration and percolation, reduces evaporation from the soil surface, and protects emerging seedlings (Majerus 1996).

Seed Mixtures. Seed mixtures would be specified on a site-specific basis and their selection would be justified in terms of local vegetation and soil conditions. Livestock palatability and wildlife habitat needs would be given consideration in seed mix formulation. The recommended general seed mixtures shown in Table 2-1 were developed from observation of successful revegetation projects in the Green River Basin region and observation of dominant species in the project area. BLM guidance for native seed use is BLM Manual 1745 (Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants). The WGFD recommends that BLM consider shrub species in seed mixtures. BLM would coordinate with WGFD to insure that the correct shrub species are incorporated into seed mixtures on public lands. Native species to be considered include bluebunch wheatgrass, streambank wheatgrass, bottlebrush squirreltail, needle-and-thread grass and Wyoming big sagebrush.

Fall seeding would occur from about September 15 until ground freeze or snow pack prevents critical seed soil coverage. The optimum time to seed a forage or cover crop in saline-alkaline soils is late fall (mid-October to December) or during a snow-free period during the winter (Majerus 1996). Ideally, in saline-alkaline soils, the seed should be in the ground before the spring season so that it can take advantage of the diluting effects of early spring moisture. Spring seeding would be completed by May 30 or as directed by the BLM. Seed would be used within 12 months of testing.

Seeding Method. Drill seeding would be used where the terrain is accessible by equipment. The planting depth for most forage species is 1/4 to 1/2 inch (5-10 mm). A double disk drill equipped with depth bands would ensure optimum seed placement. The seed would be separated by boxes to prevent seed from separating due to size and weight. Rice hulls or other appropriate material would be added to the seed as necessary to prevent separation. The drill would be properly calibrated so that seed is distributed according to the rates specified for each seed mix.

Table 2-2. Bureau of Land Management Recommended Seed Mixes for Disturbed Surface Land Areas in the RSFO Management Area (USDI-PFO 1999 and Glennon 2003).

Plant Species	Variety (if applicable)	Recommended Drill Seeding Rate (lbs/ac PLS)[A]
SALINE/SODIC SOILS		
Western wheatgrass	'Rosanna'	4.0
Sandberg bluegrass		2.0
Indian ricegrass		3.0
Bottlebrush squirreltail		1.0
Alkali sacaton		1.0
Inland saltgrass		1.0
Scarlet globemallow		1.0
Gardner saltbush		2.0
Shadscale		2.0
TOTAL		**17.0**
WETLAND/HIGH WATER SOILS		
Tufted hairgrass		2.0
Basin wildrye		5.0
Slough grass		6.0
Bluejoint reedgrass		3.0
Alkali sacaton		1.0
TOTAL		**17.0**
UPLAND SOILS		
Thickspike wheatgrass	'Critana'	4.0
Western wheatgrass	'Rosanna'	4.0
Indian ricegrass		4.0
Shadscale		1.0
Scarlet globemallow		1.0
Winterfat		2.0
Gardner saltbush		1.0
Sandberg bluegrass		2.0
TOTAL		**19.0**

[A] Pounds/acre Pure Live Seed.

Although not anticipated to be common in the project area, areas too steep for drill seeding or where approved by the BLM, broadcast seeding may also be used. Broadcasted seed should occur onto a rough seedbed and then should be lightly harrowed, chained or raked to cover the seed. The seeding rate should be doubled for the recommended mixtures because the mixtures were developed for drill seeding. The method used to cover the seed should be selected so that the seed is lightly covered but maintains the surface in rough condition. The broadcast seeder should be properly calibrated or the seeding should occur over a calculated known area so that the proper seeding rate is applied.

Mulching. Where mulching is deemed necessary, a certified weed-free, straw or hay mulch would be crimped into the soil at an application rate of two to four tons per acre. Mulches would be applied by blowers, spreaders or by hand. The mulch would not be finely shredded during application and mulch strand lengths would be long enough to be anchored by crimping. The mulch would be spread uniformly over the area so that 75% percent or more of the ground surface is covered. Mulch would be crimped to a depth of two to three inches.

2.1.10.2 Final Reclamation/Abandonment

During final reclamation and abandonment, Anadarko would obtain necessary authorizations from the appropriate regulatory agencies or private landowners to abandon facilities. Wells would be permanently or temporarily plugged or shut-in until decisions are reached regarding future production options. Pipelines would be purged of all combustible products and retired in place or removed, based on authorizing agency or landowner specifications. All aboveground facilities would be removed, and all unsalvageable materials would be disposed of at authorized sites. Roads would be reclaimed or left in place based on authorizing agency or landowner preference. Reclamation procedures would be based on site-specific requirements and techniques commonly employed at the time the area is reclaimed. Regrading, topsoiling, and revegetation of disturbed lands would be completed. Abandoned ROWs would revert to the private landowner or appropriate agency control. Compacted areas would be thoroughly ripped to a depth of 12-18 inches before topsoil is replaced. A seed mix approved by the BLM or private landowner would be broadcast or drill seeded on these affected lands. The types and approximate acreage of surface disturbance on federal land for the Proposed Action and No Action alternative are summarized in Table 2-2.

2.1.11 Applicant-committed Practices

2.1.11.1 Project-Wide Mitigation Measures and Procedures

Anadarko proposes to implement the following mitigation measures, procedures, and management requirements on public lands administered by the BLM to avoid or mitigate resource or other land use impacts. On lands owned by Anadarko, the company would determine which measures would be applied, to what degree, and where. Anadarko would coordinate with the State of Wyoming as to application of mitigation on state-owned lands. An exception to a mitigation measure and/or design feature may be approved on public land on a case-by-case basis when deemed appropriate by the BLM. An exception would be approved only after a thorough, site-specific analysis determined that the resource or land use for which the measure was put in place is not present or would not be significantly impacted.

2.1.11.1.1 Preconstruction Planning and Design Measures

- Anadarko and the BLM would make on-site interdisciplinary (ID) team inspections of each proposed and staked facility site (e.g., well sites), new access road, access road reconstruction, and pipeline alignment projects so that site-specific recommendations and mitigation measures can be developed.

- New road construction and maintenance of existing roads in the CRPA would be accomplished in accordance with BLM Manual 9113 standards unless private landowners or the State of Wyoming specify otherwise.

- Anadarko would prepare and submit an APD for each drill site on federal leases to the BLM for approval prior to initiation of construction and would be subject to additional environmental review. Also, prior to construction, Anadarko or its contractors would submit Sundry Notices and/or ROW applications for pipelines and access road segments on federal leases. The APD would include a Surface Use Plan that would show the layout of the drill pad over the existing topography, dimensions of the pad, volumes and cross sections of cut and fill (when required), location and dimensions of reserve pit(s), and access road egress and ingress. The APD, Sundry Notice, and/or ROW application plan would also itemize project administration, time frame, and responsible parties.

- Anadarko would slope-stake construction activities when required by the BLM (e.g., steep and/or unstable slopes) and receive approval from the BLM prior to start of construction.

2.1.11.2 Resource-Specific Requirements

Anadarko proposes to implement the following resource-specific mitigation measures, procedures, and management requirements on public lands managed by the BLM.

2.1.11.2.1 Range Resources/Other Land Uses/Invasive/Noxious Weed Monitoring and Management

- Anadarko will coordinate with the affected livestock operators to ensure that livestock control structures remain functional during drilling and production operations.

- Incorporate best known weed prevention measures as outlined in Appendix 4 of Partners *Against Weeds: An Action Plan for the Bureau of Land Management*.

- Incorporate invasive/noxious weed management strategies into the preconstruction planning and design process for all surface disturbance activities including road, pipeline, well pad and ancillary facility construction.

- Inventory and remove existing invasive/noxious weed seed sources that could be transported into relatively weed-free areas by passing vehicles.

- Clean muddy off-road equipment before moving into relatively weed-free areas.

- Minimize removal of native vegetation during construction of roads, pipelines, well pads and ancillary facilities.

- Stabilize disturbed areas and reestablish vegetation on all bare ground using mixtures and treatment guidelines prescribed in the approved APD/ROW as soon as practical to minimize weed spread.

- Store gravel, top soil and fill in relatively weed-free areas.

- Where possible, limit access to all disturbed sites that are not yet re-vegetated.

- Monitor disturbed and re-vegetated sites to ensure that desired species are thriving and invasive/noxious weeds are not present. Treat, reseed and fertilize as necessary.

- Monitor roads and other disturbed areas throughout the life of the project and for three years after reclamation to insure that invasive/noxious weeds are identified and eradicated.

- Ensure that all invasive/noxious weed control measures adhere to standards in the Decision Record for the Rock Springs District Noxious Weed Control EA or applicable updated guidance.

- Cooperate with the Sweetwater County Weed and Pest District to identify appropriate methods of weed control.

- Before treatment of invasive/noxious weeds, submit Pesticide Use Proposal (PUP) to the BLM for approval, ensure that all pesticides intended for use are on the BLM's approved label list for use on public lands (the label list is updated each year). The PUP(s) s must be approved prior to any spraying. PUP's can be approved for up to a three year period.

- Ensure that pesticide applicators are certified with an up to date Pesticide Applicator's License before performing spraying work.

- Submit Pesticide Application Records to the BLM RSFO each year. Ensure that treatments comply with all federal and state regulations regarding use of pesticides, including those outlined in the following:

    - BLM Information Bulletin No. WY-98-106, *Weed Management Guidance*;
    - Instruction Memorandum No. WY-99-29, *Executive Order #13112 : Invasive Species*;
    - Washington Information Bulletin No. 99-110; *Submission of Pesticide Use Report*;
    - Information Bulletin No. WY-2000-25: *Annual Pesticide Use Report.*

Mitigation requirements listed under Soils, Vegetation and Wetlands, and Wildlife also apply to Range Resources and Other Land Uses.

2.1.11.2. 2 Air Quality

- All BLM conducted or authorized activities (including natural gas development alternatives) must comply with applicable local, state, tribal and Federal air quality regulations and standards. Anadarko would adhere to all applicable ambient air quality standards, permit requirements (including preconstruction, testing, and operating permits), motorized equipment and other regulations, as required by the State of Wyoming, Department of Environmental Quality, Air Quality Division (WDEQ-AQD).

- Anadarko would not allow burning garbage or refuse at well locations or other facilities. Any other open burning would be conducted under the permitting provisions of Chapter 10, Section 2 of the Wyoming Air Quality Standards and Regulations (WDEQ-AQD).

- On Federal land, Anadarko would initiate immediate abatement of fugitive dust (by application of water, chemical dust suppressants, or other measures) when air quality, soil loss, or safety concerns are identified by the BLM or the WDEQ-AQD. These concerns include, but are not limited to, potential exceedances of applicable air quality standards. The BLM would approve the control measure, location, and application rates. If watering is the approved control measure, the operator must obtain the water from state-approved source(s).

- Anadarko would seed appropriate permits and/or follow state protocol for approval of all on-site temporary or permanent equipment used in association with this project from the Wyoming Department of Environmental Quality, Air Quality Division.

2.1.11.2.3 Transportation

- Existing roads should be used as collectors and local roads whenever possible. Standards for road design should be consistent with BLM Road Standards Manual Section 9113.

- Roads not required for routine operation and maintenance of producing wells and ancillary facilities would be permanently blocked, reclaimed, and revegetated.

- Areas with important resource values, steep slopes and fragile soils should be avoided where possible in planning for new roads.

2.1.11.2.4 Minerals/Paleontology

Mitigation measures presented in the Soils and Water Resources sections would avoid or minimize many of the potential impacts to the surface mineral resources. Protection of subsurface mineral resources from adverse impacts would be provided by the BLM casing and cementing policy.

Impacts to fossil resources can be reduced by the implementation of paleontologic resource mitigation measures. These measures include the following:

Field Survey. Detailed preconstruction field surveys should be conducted within the CRPA in area where construction would disturb surface exposures or subsurface bedrock of the Green River, Wasatch, and Fort Union. Field survey would involve a visual examination of the formation by a BLM-approved paleontologist in areas of exposure and would recommend additional mitigation. A report of findings, including recommendations for further mitigation or negative findings must be filed by the BLM-approved paleontologist and approved by the BLM before work can be authorized. After review of the paleontologist's report, the BLM will determine the need for additional mitigation measures. These could include collection of specimens and monitoring of excavation.

Worker Instruction. Construction personnel would be instructed about the types of fossils they could encounter and the steps to take if they uncover fossils during construction. Workers would be informed that destruction, collection or excavation of vertebrate or other scientifically-significant invertebrate or plant fossil materials from federal land without a federal permit is illegal and they and their company could face charges if they knowingly destroy or remove fossils.

Discovery Contingency. Should fossil resources be uncovered during surface disturbance associated with the Proposed Action, authorized personnel should immediately notify the BLM and work should cease immediately in the area of the discovery until authorized by the BLM AO. A BLM-approved paleontologist may be needed to evaluate the fossil material. If fossil remains of significance are identified then additional mitigation measures may be required. Additional mitigation could include avoidance, collection, identification, and monitoring and may delay resumption of work.

If field survey does not reveal significant fossils, no additional work for paleontology may be recommended in the areas surveyed.

2.1.11.2.5 Soils

- Reduce the area of disturbance to the absolute minimum necessary for construction and production operations while providing for the safety of the operation.

- Where feasible, locate pipelines immediately adjacent to roads to avoid creating separate areas of disturbance and in order to reduce the total area of disturbance.

- Avoid using frozen or saturated soils as construction material.

- Minimize construction activities in areas of steep slopes.

- Design cutslopes in a manner that would allow retention of topsoil, surface treatment such as mulch, and subsequent revegetation.

- Selectively strip and salvage topsoil or the best suitable medium for plant growth from all disturbed areas to a minimum depth of 6 inches on all well pads.

- Where possible, minimize disturbance to vegetated cuts and fills on existing roads that are improved.

- Install runoff and erosion control measures such as water bars, berms, and interceptor ditches if needed.

- Install culverts for ephemeral and intermittent drainage crossings. Design all drainage crossing structures to carry the 25- to 50-year discharge event, or as otherwise directed by the BLM.

- Implement minor routing variations during access road layout to avoid steep slopes adjacent to ephemeral or intermittent drainage channels. Disturbance will not encroach within 500 feet of perennial surface water and 100 feet of the thalweg in ephemeral channels. (See item 3 in Section 2.1.11.2.6 below).

- Include adequate drainage control devices and measures in the road design (e.g., road berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipators) at sufficient intervals and intensities to adequately control and direct surface runoff above, below, and within the road environment to avoid erosive concentrated flows. In conjunction with surface runoff or drainage control measures, use erosion control devices and measures such as temporary barriers, ditch blocks, erosion stops, mattes, mulches, and vegetative covers. Implement a revegetation program as soon as possible to re-establish the soil protection afforded by a vegetal cover.

- Upon completion of construction activities, restore topography to near pre-existing contours at the well sites, along access roads and pipelines, and other facilities sites; replace up to 6 inches of topsoil or suitable plant growth material over all disturbed surfaces; apply fertilizer as required; seed; and mulch.

2.1.11.2.6 Water Resources

Other mitigation measures listed in the Soils, and Vegetation and Wetlands sections would also apply to Water Resources.

- Limit construction of drainage crossings to no-flow periods or low-flow periods.

- Minimize the area of disturbance within perennial, ephemeral and intermittent drainage channel environments.

- Prohibit construction of well sites, access roads, and pipelines within 500 feet of surface water and/or riparian areas, and 100 feet from the thalweg of ephemeral channels. Possible exceptions to this would be granted by the BLM based on an environmental analysis and site-specific mitigation plans.

- Design channel crossings to minimize changes in channel geometry and subsequent changes in flow hydraulics.

- Maintain vegetation barriers occurring between construction activities and perennial, ephemeral and intermittent flows or channels, with the exception of approved right angle linear feature crossings, which, with the exception of the active travel path of a roadway, should be reclaimed.

- Design and construct interception ditches, sediment traps/silt fences, water bars, silt fences and revegetation and soil stabilization measures if needed.

- Construct channel crossings by pipelines such that the pipe is buried a minimum of four feet below the channel bottom.

- Regrade disturbed channel beds to the original geometric configuration and the same or very similar bed material replaced.

- Case wells during drilling, and case and cement all wells in accordance with Onshore Order No. 2 to protect all high quality water aquifers. High quality water aquifers are aquifers with known water quality of 10,000 TDS or less. Include well casing and welding of sufficient integrity to contain all fluids under high pressure during drilling and well completion. Further, wells would adhere to the appropriate BLM cementing policy.

- Construct the reserve pits in cut rather than fill materials or compact and stabilize fill. Inspect the subsoil material of the pit to be constructed in order to assess soil stability and permeability and whether reinforcement and/or lining are required. If lining is required, as specified in the GRRA RMP ROD (50 feet or less to ground water and permeability grater than 10^{-7} cm/hour), line the reserve pit with a reinforced synthetic liner at least 12 mils in thickness and a bursting strength of 175 x 175 pounds per inch (ASTMD 75179). Reserve Pit lining requirements will be handled on a case-by-case basis during the APD process taking into consideration water quality, soil permeability, and depth to groundwater.

- Maintain two feet of freeboard on all reserve pits to ensure the reserve pits are not in danger of overflowing. Shut down drilling operations until the problem is corrected if leakage is found outside the pit.

- Extract hydrostatic test water used in conjunction with pipeline testing and all water used during construction activities from sources with sufficient quantities and through appropriation permits approved by the State of Wyoming.

- Discharge hydrostatic test water in a controlled manner onto an energy dissipator. The water is to be discharged onto undisturbed land that has vegetative cover, if possible, or into an established drainage channel. Prior to discharge, treat or filter the water to reduce pollutant levels or to settle out suspended particles if necessary. If discharged into an established drainage channel, the rate of discharge would not exceed the capacity of the channel to safely convey the increased flow, and the hydrostatic test water quality would be equal to or better than the receiving waters. Coordinate all discharge of test water with the Wyoming State Engineer's Office (SEO), Wyoming Department of Environmental Quality/Water Quality Division (WDEQ/WQD), and the BLM.

- Discharge all concentrated water flows within access road ROWs onto or through an energy dissipator structure (e.g., riprapped aprons and discharge points) and discharge into undisturbed vegetation.

- Develop and implement a pollution prevention plan (PPP) for storm water runoff at drill sites as required per Wyoming Department of Environmental Quality (WDEQ) storm water National Pollution Discharge Elimination System (NPDES) permit requirements. The WDEQ requires operators to obtain a field permit for fields of 20 wells or more.

- Exercise stringent precautions against pipeline breaks and other potential accidental discharges of toxic chemicals into adjacent streams. If liquid petroleum products are stored on-site in sufficient quantities (per criteria contained in 40 CFR Part 112), a Spill Prevention Control and Countermeasures (SPCC) plan would be developed in accordance with 40 CFR Part 112, dated December 1973.

- Coordinate all crossings or encroachments of waters of the U.S. with the U.S. Army Corps of Engineers (COE).

- Discharge all water produced from the gas bearing formation(s) into tanks, pumps, pipelines, and existing injection wells to preclude contamination of surface waters with high mineral content formation water.

2.1.11.2.7 Fisheries

- No fisheries mitigation is needed beyond that indicated under Water Resources and Special Status Species Fish.

2.1.11.2.8 Vegetation and Wetlands

Other mitigation measures under Soils and Water Resources would also apply to vegetation and wetlands.

- File noxious weed monitoring forms with the BLM and implement, if necessary, a weed control and eradication program.

- Evaluate all project facility sites for occurrence and distribution of waters of the U.S., special aquatic sites, and jurisdictional wetlands. All project facilities would be located out of these sensitive areas. If complete avoidance is not possible, minimize impacts through modification and minor relocations. Coordinate activities that involve dredge or fill into wetlands with the COE.

2.1.11.2.9 Wildlife

- During reclamation, establish a variety of forage species that are useful to resident herbivores.

- Prohibit unnecessary off-site activities of operational personnel in the vicinity of the drill sites. Inform all project employees of applicable wildlife laws and penalties associated with unlawful take and harassment.

- Limit construction activities as per BLM authorizations within big game crucial winter range from November 15 to April 30.

- Complete a raptor survey of the CRPA prior to construction to ensure that well sites are located away from potential conflict areas.

- Survey and clear well sites within one mile of raptor nests identified in the raptor survey prior to the commencement of drilling and construction during the raptor nesting period (February 1 through July 31).

- When an `active' raptor nest is within one mile (Ferruginous Hawk) or ½ mile (all other raptors) of a proposed well site, restrict construction during the critical nesting season for that species.

- Do not perform construction activities within 0.25 mile of existing sage grouse leks at any time except as authorized in writing by exception, including documented supporting analysis, by the Authorizing Official. All surface disturbances would abide by sage-grouse stipulations as detailed in the GRRA RMP ROD and supporting documents.

Provide for sage grouse lek protection during the breeding, egg-laying and incubation period (March 1 - June 30) by restricting construction activities within a two-mile radius of active sage grouse leks. Exceptions may be granted if the activity would occur in unsuitable nesting habitat.

2.1.11.2.10 Special Status Species

Special Status Plants

- Employ site-specific recommendations developed by the BLM IDT for staked facilities.
- Minimize impacts due to clearing and soil handling.
- Monitor and control noxious weeds.
- Comply with Section 404(b) (1) guidelines of the federal Clean Water Act (CWA).

Perform clearance surveys for plant species of concern.

Special Status Animals

- Implement measures discussed in Chapter 4 (Section 4.8) in compliance with the Endangered Species Act (ESA),

2.1.11.2.11 Visual Resources

- Utilize existing topography, vegetation, and color that mimic the existing environment to screen roads, pipeline corridors, drill rigs, well heads, and production facilities from view.
- Paint well and central facilities site structures with flat colors (e.g., Carlsbad Canyon or Desert Brown) that blend with the adjacent surrounding undisturbed terrain, except for structures that require safety coloration in accordance with Occupational Safety and Health Administration (OSHA) requirements.

2.1.11.2.12 Noise

- Muffle and maintain all motorized equipment according to manufacturers' specifications.

2.1.11.2.13 Recreation

Measures under Wildlife, Transportation, Soils, Health and Safety, and Water Resources apply to Recreation.

- Minimize conflicts between project vehicles and equipment and recreation traffic by posting appropriate warning signs, implementing operator safety training, and requiring project vehicles to adhere to low speed limits.
- Monitor recreational use of roads, especially during hunting seasons.

2.1.11.2.14 Socioeconomics

- Implement hiring policies that would encourage the use of local or regional workers who would not have to relocate to the area.

- Coordinate project activities with ranching operations to minimize conflicts involving livestock movement or other ranch operations. This would include scheduling of project activities to minimize potential disturbance of large-scale livestock movements. Establish effective and frequent communication with affected ranchers to monitor and correct problems and coordinate scheduling.

- Anadarko and its subcontractors would obtain Sweetwater County sales and use tax licenses for purchases made in conjunction with the project so that project-related sales and use tax revenues would be distributed to Sweetwater County.

2.1.11.2.15 Cultural Resources

- Conduct a Class III inventory prior to any ground disturbing activities and identify sites considered eligible for, or already on the NRHP.

- If a site is considered eligible for, or is already on the National Register of Historic Places (NRHP), avoidance is the preferred method for mitigating adverse effects to that property.

- Mitigation of adverse effects to cultural/historical properties that cannot be avoided would be accomplished by the preparation of a cultural resources mitigation plan.

- If unanticipated or previously unknown cultural resources are discovered at any time during construction, all construction activities would halt and the BLM Authorized Officer (AO) would be immediately notified. Work would not resume until a Notice to Proceed is issued by the BLM AO.

2.1.11.2.16 Health and Safety

Measures listed under Air Quality and Water Quality also apply to Health and Safety.

- Sanitation facilities installed on the drill sites and any resident camp site locations would be approved by the WDEQ.

- To minimize undue exposure to hazardous situations, require measures that would preclude the public from entering hazardous areas and place warning signs alerting the public of truck traffic.

- Haul all garbage and rubbish from the drill site to a State-approved sanitary landfill for disposal. Collect and store any garbage or refuse materials on location prior to transport in containers approved by the BLM.

- During construction and upon commencement of production operations, Anadarko would have a chemical or hazardous substance inventory for all such items that may be at the site. Anadarko would institute a Hazard Communication Program for its employees and would require subcontractor programs in accordance with OSHA 29 CFR 1910.1200. These programs are designed to educate and protect the employees and subcontractors with respect to any chemicals or hazardous substances that may be present in the work place. It would be required that as every chemical or hazardous material is brought on location, a Material Safety Data Sheet (MSDS) would accompany that material and would become part of the file kept at the field office as required by 29 CFR 1910.1200. All employees would receive the proper training in storage, handling, and disposal of hazardous substances.

- Spill Prevention Control and Countermeasure Plans would be written and implemented as necessary in accordance with 40 CFR Part 112 to prevent discharge into navigable waters of the United States.

- Chemical and hazardous materials would be inventoried and reported in accordance with the Superfund Amendments and Reauthorization Act (SARA) Title III. 40 CFR Part 335, if quantities exceeding 10,000 pounds or the threshold planning quantity (TPQ) are to be produced or stored in association with the Proposed Action. The appropriate Section 311 and 312 forms would be submitted at the required times to the State and County Emergency Management Coordinators and the local fire departments.

- Any hazardous wastes, as defined by the Resource Conservation and Recovery Act (RCRA), would be transported and/or disposed of in accordance with all applicable federal, state, and local regulations.

- Anadarko plans to design operations to severely limit or eliminate the need for Extremely Hazardous substances. Anadarko also plans to avoid the creation of hazardous wastes as defined by RCRA wherever possible.

2.2 ALTERNATIVE A - NO ACTION

Section 1502.14(d) of the National Environmental Policy Act (NEPA) requires that the alternatives analysis "include the alternative of no action". "No Action" implies that on-going natural gas production activities would be allowed to continue by the BLM in the CRPA, but the proposed field development program (Proposed Action) would be denied. Additional APDs and ROW actions would be considered by the BLM for federal land on a case-by-case basis consistent with the scope of existing environmental analysis. Transport of natural gas products would be allowed from those wells within the CRPA that are currently productive. Additional gas development could occur on private lands within the project area under APDs approved by the WOGCC.

Because the project lies within the checkerboard where Anadarko owns the private surface/minerals, and access already approved to most of the area by BLM through rights-of-way actions, the No Action Alternative would entail continued drilling on private lands (and potentially could lead to additional drilling on public lands to resolve drainage issues). Thus, for purposes of this analysis, the No Action Alternative acknowledges continued development on the private estate, but assumes no further drilling on public lands beyond that already authorized with approved APD's.

Assuming that no new federal wells would be permitted, Anadarko estimates that 48 wells and associated infrastructure would be developed under the No Action Alternative, as shown in Figure 2-1. Table 2-3 shows surface disturbances anticipated for the No Action Alternative.

Table 2-3. Types and Approximate Acreage of Surface Disturbance on Federal Land - No Action Alternative.

No Action Alternative									
	Estimated Life-of-Project (LOP) Disturbance Area (acres)					Estimated Initial Disturbance Area (acres)			
Type of Disturbance	Federal	Private	State	Total		Federal	Private	State	Total
Number of Wells	0	46	2	48		0	46	2	48
Well Pads[1]	0.0	46	2	48		0.0	92	24	96
Roads[2]	16.36	41.81	1.8	59.97		32.72	83.62	3.6	119.94
Compressor[5]	0.0	0.9	0.0	0.9		0.0	0.9	0.0	0.9
Pipelines[3,4]	0.0	0.0	0.0	0.0		49.09	125.45	5.45	179.99
Total	**16.36**	**88.71**	**3.8**	**108.87**		**81.81**	**301.97**	**33.05**	**396.83**

[1]Assumes initial disturbance of approximately 2 acres for each well pad and LOP disturbance of 1 acre per well pad.
[2]Assumes an average of 0.25 mi of new roads with parallel gas gathering and water discharge lines (60-ft average disturbance width) for each well. All disturbance except for the estimated 30-ft wide road travelway and adjacent ditches would be reclaimed for the LOP.
[3]Assumes an average of 0.75 mi of new gas gathering and water discharge lines per well of which approximately 0.50 mi will be constructed within existing pipeline corridors.
[4]Assumes an average disturbance width of 30 ft.
[5] The compressor station (about 0.9 acres of disturbance) would be located on private land.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Based on technical information provided by Anadarko, the BLM examined utilization of horizontal or directional drilling to minimize surface disturbance. Use of such drilling methods would allow the clustering of surface facilities. This alternative is not given further consideration for the following reasons:

- Economics – horizontally drilled wells are estimated to cost 5 to 10 times as much as similar vertically drilled wells with no commensurate increase in production. This is due to the requirement to drill many laterals (up to 24) to develop the gas resource in a formation with up to 24 coal seams. In addition, horizontal laterals would not be economical in thin seams as the cost of each lateral would exceed the return on ultimate gas recovery. In conventional drilling, these seams would contribute to overall production, therefore maximizing recovery of the gas resource.
- Reservoir issues – the science of CBM wells and the Copper Ridge formation in

particular (targeted interspersed coal and sands), does not warrant horizontal wells for the purpose of intersecting naturally occurring vertical fractures, which is one reason to horizontally drill. The coals of the Almond Coal formation are made up of three subgroups of coals, with 8 to 12 seams ranging in thickness from 1 to 10 feet. Some Almond coal seams correlated between wells over long distances, but there are still a high number of seams or riders that do not correlate from well to well. Thin or discontinuous target zones are poor prospects for horizontal drilling. In addition, horizontal drilling technology requires precise control of target locations in three dimensions. Even the thickest coal seams in the project area are below the vertical resolution of current seismic technology and yield no target control for lateral drilling. Thus, without the knowledge of coal seam locations, directional drilling would not produce the desired results.

- Surface disturbance – Typical vertical well requires approximately 1 acre or less of rig footprint. Horizontal laterals would require a larger rig. Larger rigs are currently using 2 acre or larger footprint depending on the depth of the well and the length of the horizontal. A horizontal well would need to take the place of more than four conventional vertical wells before experiencing net loss in well site surface disturbance.

CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental assessment (EA) for the proposed Anadarko Shallow Gas Development project discusses environmental, social, and economic factors as they currently exist within the Copper Ridge project area (CRPA). The material presented here has been guided by management issues identified by the Bureau of Land Management (BLM), Rock Springs Field Office; public scoping; and by interdisciplinary field analysis of the area.

This proposal could potentially affect critical elements of the human environment as listed in BLM's National Environmental Policy Act (NEPA) Handbook H-1790-1 (USDI-BLM 1988) (Table 3-1). This EA discusses potential effects of the project on range resources, air quality, transportation, geology/minerals/paleontology, soils, water resources, vegetation (including invasive and non-native species) and wetlands, wildlife, special status species, visual resources, noise, recreation, socioeconomics (including environmental justice), cultural resources (including native American religious concerns), and health and safety (including hazardous and solid waste). The resource elements to be analyzed in this EA are summarized in Table 3-2.

Table 3-1. Critical Elements of the Human Environment[1], Copper Ridge Shallow Gas Project Sweetwater County, Wyoming

Element	Status on the Project Area	Addressed in text of EA
Air Quality Issues	Potentially affected	Yes
Areas of critical environmental concern	None present	No
Cultural resources	Potentially affected	Yes
Environmental justice	Potentially affected	Yes
Prime or unique farmlands	None present	No
Floodplains	None present	No
Native American religious concerns	Potentially affected	Yes
Invasive plants	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Hazardous or solid wastes	None present	No
Water quality (surface water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic rivers	None present	No
Wilderness (study area)	None present	No

[1] As listed in BLM *National Environmental Policy Act Handbook H-1790-1* (BLM 1988b) and subsequent Executive Orders

Table 3-2. Other Elements for Analysis, Copper Ridge Shallow Gas Project Sweetwater County, Wyoming.

Element	Status on the Project Area	Addressed in text of EA
Geology/Minerals/Paleontology/Hazards	Potentially affected	Yes
Soils	Potentially affected	Yes
Vegetation	Potentially affected	Yes
Wildlife	Potentially affected	Yes
Special Status Species	Potentially affected	Yes
Noise	Potentially affected	Yes
Visual Resources/Recreation	Potentially affected	Yes
Ground Water	Potentially affected	Yes
Socioeconomic Issues	Potentially affected	Yes
Range/Other Uses	Potentially affected	Yes
Cumulative Impacts	Potentially affected	Yes

3.1 GEOLOGY/MINERALS/PALEONTOLOGY

3.1.1 Geology

3.1.1.1 Overview

The CRPA lies on the southeast flank of the Rock Springs Uplift, a major Laramide structural element, and is part of the Wyoming Basin Physiographic Province. The uplift is a north-south trending, doubly plunging asymmetric anticline that formed during Late Cretaceous time and showed intermittent activity during the Early Tertiary. Breaching of the anticline has exposed a complete section of Upper Cretaceous Mesaverde Group in its core. In ascending order, the Mesaverde consists of the marine Baxter and Blair Formations, the coal-bearing Rock Springs Formation, the fluvial Ericson Formation, and the coal-bearing Almond Formation. The Mesaverde Group is overlain by coal-bearing rocks of the Lance (Latest Cretaceous) and Fort Union (Paleocene) formations, the fluvial Wasatch Formation, and lacustrine Green River Formation that form the flanks of the uplift.

Structural dips on the southeast flank of the Rock Springs Uplift in the CRPA are gentle, measuring between 5 and 9 degrees to the southeast. A minor cross-trending fold, the Jackknife Springs Anticline interrupts the northeast strike of the beds. The axis of this fold plunges southeastward at 3° to 5°along a southeastward trend through the Brady Unit in section 32 T18N, R101W through section 11, T 16 N, R 101 W.

A major subsurface fault, the Brady Fault, bounds the northwest edge of the Brady Field. This high angle reverse fault strikes N20°E and dips 80°-85°to the southeast. At about 12,000 ft in depth, the fault crosses the center of section 10, the southeast part of section 3, and the northwest part of section 2, in T16N, R101W. The fault originates from Precambrian rocks underlying the area and dies out upward into Cretaceous rocks at a depth of about 5,000 ft (Roehler 1979). It is estimated that there are nearly 1,000 ft of structural closure along the southeast, upthrown side of the fault across the Brady Field.

Geologic mapping by the USGS and Wyoming Geologic Survey (Bradley 1964, Love 1970, Love and Christiansen 1985, Love et al. 1993, and Roehler 1977a, 1977b) document that sedimentary deposits of Quaternary and Early Tertiary age crop out in the project area. As mapped, these rocks are overlain at the surface in the drainages of Sand Wash, Black Butte Creek, Burley Draw, and Polly Draw by unconsolidated Quaternary alluvium.

Early Tertiary deposits in the CRPA consist chiefly of rocks that accumulated in swampy, terrestrial and lake environments that dominated the area during Paleocene and early Eocene time (Bradley 1964; Kirschbaum and others 1988, 1994; Love 1970; Roehler 1973 1977a-c; 1079, 1985, 1987 1991 a-b, 1992 a-c, 1993; Winterfeld 1982). These deposits comprise three geologic units, from youngest to oldest, the Green River Formation, Wasatch Formation, and Fort Union Formation. Stratigraphy of the Eocene Wasatch and Green River Formations in southwestern Wyoming is shown on Figure 3-1.

An angular unconformity separates the Fort Union Formation from the underlying Cretaceous rocks of the Lance Formation and apparently from overlying Eocene rocks of the Wasatch Formation. An intraformational unconformity, marked by a well-developed fossil soil horizon, separates the upper and lower unnamed units of the Fort Union Formation. The unconformities document the intermittent activity of the Rock Spring Uplift during Early Tertiary time.

Green River Formation

Rocks of the Green River Formation (Early Eocene) exposed within the CRPA include from youngest to oldest the Wilkins Peak Member, Tipton Tongue, and Luman Tongue. All three members crop out only along the eastern edge of the area and accumulated in the ancient Green River Lakes system. None of the members contain economic mineral deposits, but do produce vertebrate fossils of scientific significance.

Only the lower 60 ft or so of the Wilkins Peak Member occurs within the area. These rocks consist of brown flaky oil shale and thin interbedded gray tuff, gray and brown mudstone, gray dolomite, and tan algal limestone that accumulated in ancient Lake Gosiute (Roehler 1974, 1977a-b, 1991 a-b; 1992 a-c, 1993). The Wilkins Peak Member weathers to low slopes that form the top of Six Mile Rim.

The Tipton Shale consists of a maximum of about 60 feet of brown flaky oil shale and very thin interbedded brown ostracodal limestone and brown tuffaceous siltstone that underlie the Wilkins Peak Member of the and overlie the Niland Tongue of the Wasatch Formation. Beds of the Tipton and underlying upper rocks of the Niland Tongue weather to form Sixmile Rim. The Luman Tongue consists of a maximum of about 350 ft of organic-rich carbonaceous shale, limestone, sandstone, and mudstone that underlie the Niland Tongue and overlie the main body of Wasatch Formation. The Luman weathers to form a prominent bench below Sixmile Rim.

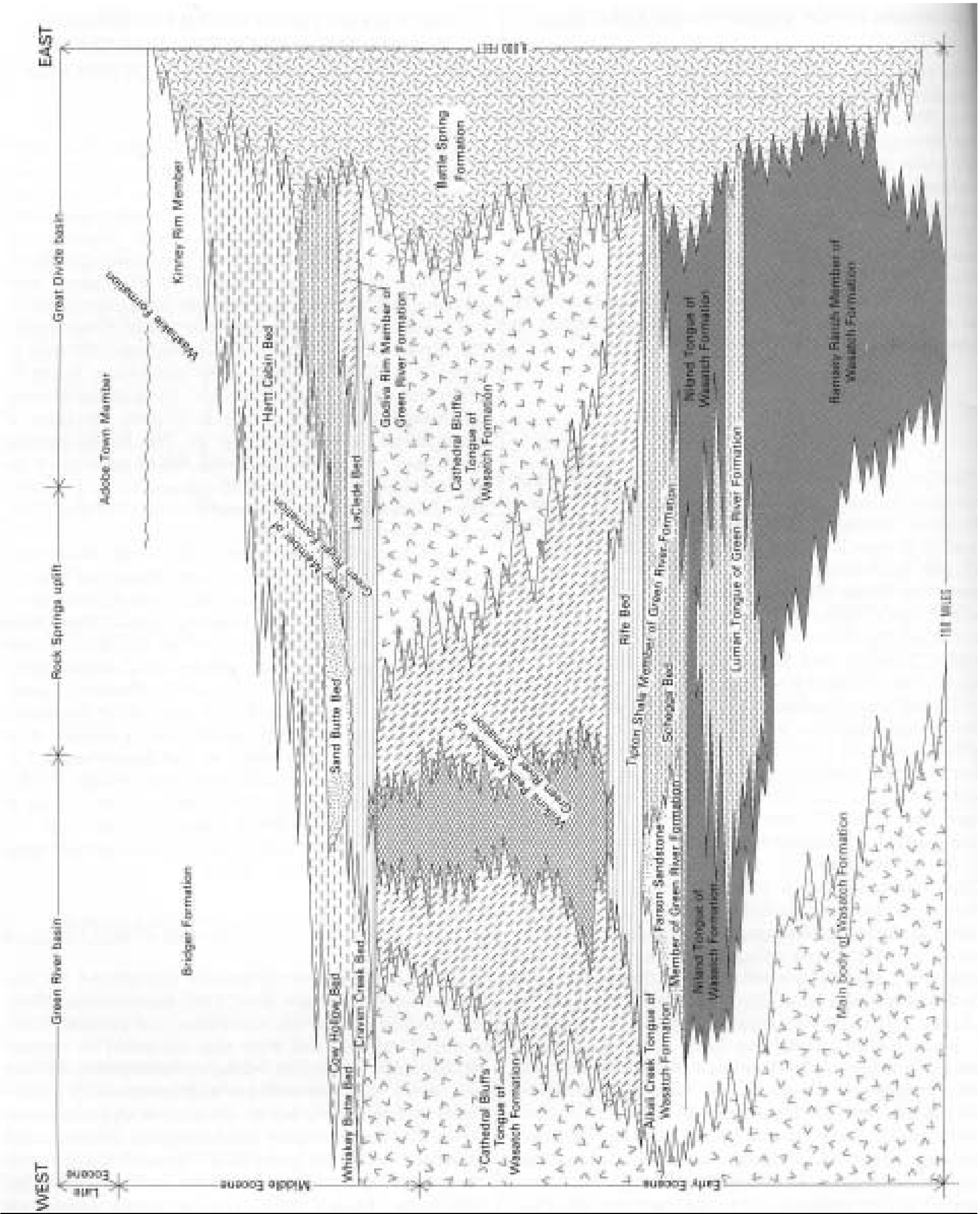


Figure 3-1. Stratigraphy of the Eocene Wasatch and Green River Formations in southwestern Wyoming

Wasatch Formation

Rocks of the Wasatch Formation (Early Eocene) exposed in the CRPA include two members, the Niland Tongue and main body. The Niland Tongue, the upper of the two forms the lower part of Six Mile Rim. The main body of the Wasatch Formation is broadly exposed over the central part of the area, where it weathers to a series of northeast trending, low-lying ridges and valleys. Neither member contains economic mineral accumulations, but both produce scientifically significant vertebrate fossils.

The Niland Tongue consists of terrestrial and fluvial sediment that lies stratigraphically between the overlying Tipton Tongue and underlying Luman Tongue of the Green River Formation. Deposits of the Niland Tongue include a maximum of about 400 ft of silty to sandy mudstone and sandstone interbedded with thin beds of brown flaky oil and carbonaceous shale and limestone. These deposits accumulated in smaller lakes, ponds, swamps, and flood plains following restriction of the Green River Lake system.

The main body of Wasatch Formation overlies the Fort Union Formation. The contact between the two formations trends along the Patrick Draw Road continuing southward along Burley Draw, with the main body occurring east of the road and draw. The main body includes a maximum of 1,500 ft of gray sandy mudstone and interbedded gray-green silty shale and gray very fine to fine grained sandstone that accumulated chiefly in fluvial and well drained flood plains during Early Eocene time.

Fort Union Formation

The Fort Union Formation (Paleocene) crops along the western edge of the CRPA. The formation is a maximum of about 1,300 ft thick and crops out chiefly west of the area. The formation consists of drab gray and brown mudstone and interbedded siltstone, sandstone, carbonaceous shale, orange to tan limestones and coal that accumulated in swampy to fluvial environment during the middle and late Paleocene. Like the main body of the Wastach, the Fort Union formation weathers to a series of northeast-trending low valleys and ridges. Pollen (Kirschbaum and others 1988, 1994, Nicols 1999) and vertebrate fossils (Winterfeld 1983, Wilf and others 1998) indicate that earliest Paleocene strata are missing from the section along the eastern flank of the Rock Springs Uplift because of an intraformational unconformity. The Fort Union Formation contains economic coal deposits, primarily in the lower half of the formation, and produces vertebrate fossils of scientific significance.

Older Sedimentary deposits

The Fort Union Formation is underlain by Phanerozoic sedimentary rocks, which with the exception of lacking Silurian and Ordovician deposits, range in age from Cretaceous to Cambrian in age. These are in turn underlain by Precambrian metamorphic bedrock that comprise part of the ancient North American cratonic shield and probably exceeds 2 billion years in age.

3.1.1.2 Mineral Resources

3.1.1.2.1 Locatable Minerals

No locatable mineral deposits have been mapped within the CRPA.

3.1.1.2.2 Leasable Minerals

Petroleum resources occur in Cretaceous, Jurassic, and Pennsylvanian age rocks underlying the CRPA. Coal occurs in Tertiary and Latest Cretaceous age rocks exposed at the surface to the west of the area, chiefly at a depth (450 ft +) too great to make strip mining economic. The coals contain potential coal bed methane resources underlying the CRPA.

Petroleum

Gas was first discovered in the Brady Field (then called the Jackknife Spring Field) in 1960 in the Almond, Rock Springs, and Blair Formations in the Mountain Fuels Supply Co. Jackknife Spring 1 well in Section 11, T16N, R101W. The discovery well was completed in the Rock Springs and Blair Formations at depths between 5,335 and 6,336 ft and had an initial flow potential of 7,220 MCF gas per day. The Brady 1 discovery well was drilled in 1972, also in section 11 and was completed in the Weber Sandstone and had an initial flow potential of 3,818 MCF gas and 976 bbl of condensate. The hydrocarbons are structurally trapped at the Brady Field by closure against the southeast, upthrown side of the Brady Fault (Roehler 1979). The field has proved productive in the Rock Springs, Blair, Dakota Sandstone (Entrada of drillers), Nugget, Park City, and Weber Formations.

Oil from the Nugget, Park City and Weber Formations has gravities ranging from 50-67 with pour points below 10° F. Gas from the Rock Springs, Blair, and Dakota formations is less than 1% inert and has high heating value. Gas from the Nugget, Park City, and Weber formations is 31-55% inert and has moderate heating value. Gas from the Park City is composed of more than 30% hydrogen sulfide. Since 1972, a total of 59 producing wells have been drilled and developed and production continues to date with cumulative production of 68,580,228 bbl oil and 572,277,598 MCF gas as of March 2003. A total of 8 additional, nonproducing wells have been plugged, abandoned and reclaimed.

Coal

Three coal beds that crop out west of the CRPA in the Fort Union Formation are projected to continue eastward beneath the area (Roehler 1977 a-b 1979). Two of these beds, the Big Burn and Hail occur within a 100 ft thick interval near the center of the upper part of the formation. These beds vary considerably in thickness laterally and do not exceed 9 ft in thickness for the Big Burn and 5 ft in thickness for the Hail bed. A third coal bed, the Little Valley Coal Bed, which is actually a zone of coal beds, crops out west of the CRPA and occurs within the lower 100 ft of the lower part of the Fort Union Formation. Individual seams within the Little Valley Coal vary considerably in thickness laterally, but may reach 15 ft thickness. Two coals, the Bluff and French coal beds, crop out near the base of the Lance Formation north and west of the CRPA area. These seams are less than 7 ft and 8.5 ft thick, respectively. They may not be present beneath the CRPA because of the unconformity at the base of the Fort Union Formation which progressively truncates the Lance southward.

Additional coal is present in the subsurface beneath the CRUA in the Mesaverde Group, including, in stratigraphic order from youngest to oldest include the Almond, Williams Fork (= Pine Ridge Sandstone) and Iles (= Allen Ridge) formations (Tyler and Hamilton 1994).

The middle of the Almond Formation of Cretaceous age underlying the Lance Formation has a

150 ft to 200 ft thick interval that contains as many as nine named and mapped coal beds. These coals are chiefly lenticular and vary considerably laterally with individual thickness. Net Almond coal thickness beneath the CRPA is less than 10 feet.

Coals in the Williams Fork (=Pine Ridge) Formation include the thickest and most extensive coals of the Upper Cretaceous in the Greater Green River Basin and are the basin's prime coalbed methane targets. These coals are interpreted to have accumulated in coastal plain environments and fluvial dominated, wave modified deltas, along a southwest-northeast oriented strand (beach) line that faced southeastward into the Cretaceous epicontinental seaway. Three depositional coal cycles are represented that accumulated in response to progradation as a result of sea level drop or changes in delta location, or both. The thickest coals in these cycles overlie shoreline sandstones with thinner and less continuous coals developed between deltaic distributary channel sandstones. Net Williams Fork coal thickness beneath the CRUA is 20 feet or less.

Coals of the Iles (Allen Ridge) Formation are thinner and not as well developed as those in the Williams Fork and the formation is considered a minor coal-bearing unit and coalbed methane target. These coals are interpreted to have accumulated in a variety of swampy environments above shoreline sandstones and in flood plains adjacent to delta river channels. Net Iles coal thickness beneath the CRUA area is less than 15 feet.

Channel samples of coal bed of the Big Burn, Little Valley and several of the coals in the Almond Formation have been analyzed. BTU values range from 6,000 to 8.900 Btu/lb which classifies them as Lignite B, Lignite, A, and Subbituminous C, but because these samples had been affected by surface weathering Roehler (1979) felt they should be ranked higher, possibly in the Lignite A to Subbituminous B range.

Coals in the Fort Union, Lance, and Almond Formations are currently being stripped mined at the Black Butte Mine about 10 miles to the north of the CRPA..

Coalbed Methane

In the Green River basin, coal and gas resources total 1,277 billion short tons, respectively (Hamilton and others 1994). The Mesaverde Group contains 627 billion tons and 264 Tcf, respectively and the Fort Union Formation contains 649 billion tons and 50 Tcf, respectively. At depths of less than 7,500 feet, coal and gas resources are estimated at 688 billion tons and 84 Tcf.

The Greater Green River Basin, including the CRPA is characterized by relatively low coal rank (Hamilton and others 1994). Coal ranks at exploitable drilling depths typically ranges from high –volatile C to high-volatile A bituminous and have barely reached the threshold of thermogenic gas generation. In the Mesaverde Group (Rock Springs and Almond Formations) coal rank around the Rock Springs Uplift is subbituminous to high-volatile C bituminous and increases with depth to high-volatile A bituminous at about 7,500 feet. Only below these depths have the coals reached ranks sufficient to generate large volumes of thermogenic gas. Fort Union coal rank around the Rock Springs Uplift is also subbituminous.

Gas contents of Greater Green River Basin coals are generally low, which is consistent with their low coal rank. Ash-free content values are typically less than 200 scf/ton for Mesaverde coals and less than 100 scf/ton for Fort Union coals. Coalbed gases are early thermogenic, thermogenic , and secondary biogenic.

Along the northeast flank of the Rock Springs Uplift, Fort Union, Almond, and Rock Springs coals have been tested. Of these, only the Rock Springs coals showed economic promise (Hamilton and others 1994). Because of their low gas content coals in the Fort Union Formation are considered to be secondary coal targets. Almond Formation coals are generally thin and are also considered secondary targets. Reservoir studies show that gas in the Almond Formation does not only originate from upper Almond sandstone, but also from numerous thin coals present in the upper Almond. These should be considered for completion.

3.1.1.3 Geologic Hazards

Naturally occurring geologic hazards include fault-generated earthquakes, floods, landslides or other mass movements. There are no known faults with surface expression or earthquake epicenters mapped within the CRPA (NEIC 2003, WGS 2003). The nearest earthquake epicenters recorded occurred within a 25 km radius of the area include those of 3 quakes that happened in 1984 a few miles northwest of Bitter Creek, Wyoming (T19N, R99W) and measured a magnitude of 3.2 on the Richter scale at a depth of 2 km.

There are no mapped landslide deposits in the area. Topographic relief is approximately 680 feet (6,960 ft to 7,640 ft) and slope over most of the area is gentle to rolling approximated by that along an east west transect to the eastern edge of the area along Black Butte Creek. There over a lateral distance of a mile elevation rises 420 ft. yielding a grade of about 8 % grade (Sec. 18, T16N, R100W). Slopes are steepest along Six Mile Rim (Sec. 32, T17N, R100W) where over a lateral distance of about 400 ft elevation rises on average 200 ft, yielding a grade of about 50%. Although steep, Six Mile Rim is developed in rocks (Wasatch and Green River Formations) that dip to the southeast opposite to the slope, which dips to the northwest, thus lessens the chance for naturally occurring mass movements.

The nearest landslides are mapped along the western edge of Sand Butte Rim about a mile east of the CRPA. These westward directed landslides are developed in the upper Wasatch Formation and overlying Green River Formation but these are of limited extent and do not extend into the project area

3.1.2 Paleontology

3.1.2.1 Paleontologic Overview

Paleontologic resources within sedimentary deposits exposed at the surface of the CRPA record the history of animal and plant life in Wyoming during the early part of the Cenozoic Era (Paleocene and Eocene Epochs). As described above, mapping documents four geologic deposits that are exposed at the surface of the CRPA. These include, from youngest to oldest: (1) unnamed deposits of Quaternary (Holocene) age; (2) Green River Formation of middle Eocene age; (3) Wasatch Formation of early Eocene age, and (4) Fort Union Formation of Paleocene age.

With the exception of the Holocene deposits that are too young to contain fossils, all sedimentary rock units exposed in the area have the potential to produce scientifically significant fossil resources. Scientifically significant fossil vertebrates have been recovered from within the area or immediately adjacent areas in the Wasatch (Morris 1954, Honey 1988, Roehler 1972, 1991 a-b, 1992 a-c, 1993, Roehler et al. 1988, Cassiliano 2003, Holroyd 2003) and Fort Union (Rigby 1980, Winterfeld 1981, Beard 2003) Formations.

Green River Formation

Plant, invertebrate (ostracod), and vertebrate fossils (fish and bird) are well known from the lower part of the Wilkins Peak Member. Freshwater gastropods, such as *Goniobasis tenera* and *Viviparus* sp., and the large unionid bivalve, *Lampsilis* as well as fish fossils occur abundantly in the Tipton Tongue, and at least one fossil mammal locality has been reported. The fossil mammal locality discovered in an ostracodal limestone, produced the mold of a jaw of the early horse *Hyracotherium*, with incisors preserved and molar impressions.

Fossils of fresh water molluscs are abundant throughout the Luman Tongue and the assemblages of fossils are commonly characterized by the large prosobranch gastropods *Goniobasis tenera* and *Viviparus sp.*, and by the large unionid bivalve, *Lampsilis*. Fish, ostracod, and trace fossils are also common in the tongue (Roehler, 1991 a-b; 1992 a-c, 1993).

Wasatch Formation

The high paleontologic potential of the Wasatch Formation in southern Wyoming is well known. Along the east flank of the Rock Springs uplift both the Niland Tongue and main body contain accumulations of fossil vertebrates (fish, turtles, crocodiles, birds and mammals), invertebrates (snails and clams), and traces and tracks of these organisms and fossil plants. Vertebrate remains include isolated bones and teeth and rarely articulated skeletal parts. The fossil mammals include primates, insectivores, marsupials, condylarths (archaic hoofed animals), artiodactyls, perissodactyls, carnivores, creodonts, bats, rodents, arctocyonids, and tillodonts.

Review of institutional records (University of California, University of Colorado, and University of Wyoming) reveals that more than 250 fossil vertebrate localities have been identified in the Wasatch Formation along the east flank of the uplift. At least two dozen fossil localities are known from the main body of the formation exposed along the east side of Patrick Draw road immediately north and south of the area. Seven localities occur within the area, primarily concentrated in the southwestern and eastern parts of the area where outcrops are best exposed. Six fossil vertebrate localities occur in the Niland Tongue immediately north of the area. To date, more than 13,000 cataloged specimens in the University of California Museum of Paleontology, the University of Colorado Museum, the U.S. National Museum, and the University of Wyoming have come from sediments of the Wasatch Formation as exposed along Patrick Draw Road (Holroyd, 2003).

The localities and specimens from them are of high scientific significance and interest because they include: (1) mammalian mass death assemblages (Williamson, 2001, and McGee, 2001, 2002) preserving skulls and skeletons of multiple individuals; (2) small mammals (Gunnell, 2001, Cuozzo, 2002), lizards (e.g., Gauthier, 1982), birds, and amphibians, many of which are new species and are the subject of ongoing study by researchers at the University of California, University of Michigan, University of Colorado, Yale University, and Las Positas College; (3) localities showing the greatest fossil bird, reptile, and mammal diversity of any area localities of early Eocene vertebrates known from North America and perhaps the world (Stidham, 1999, Holroyd and Hutchison, 2000, Holroyd, 2001); and (4) localities that are tied closely to the basin-wide stratigraphic framework (Savage et al. 1972; Roehler, 1992; and field notes on file at UCMP).

Fort Union Formation

The high potential of the Fort Union Formation exposed along the eastern flank of the Rock Springs Uplift to produce scientifically significant fossils of vertebrates, invertebrates and plants is well documented (Rigby, 1980; Winterfeld, 1982, Wilf and others 1998). Fossils vertebrate remains are known from more than 50 fossil localities presently identified in the formation. Mammal fossils from these localities include at least 70 species representing multituberculates, marsupials, proteutherians, insectivores, primates, carnivores, condylarths, pantodonts, and taeniodonts of middle to late Paleocene age (Winterfeld 1982). The uppermost rocks of the formation contain fossil mammals that mark the transition to the Eocene epoch and document the appearance of modern mammalian families in North America as well as the disappearance of archaic forms (Wilf and others 1998).

To date more than 1,500 vertebrate specimens have been collected from the formation along the east flank of the uplift. These localities and specimens from them are of high scientific significance and interest for several reasons including: (1) they yield small mammals, reptiles and amphibians many of which are new species and are the subject of ongoing study by researchers at Idaho State University (Winterfeld 2003) and the Carnegie University (Beard 2003); (2) include among them a late Paleocene age locality (Clarkforkian age) with the greatest diversity of fossil mammals known from that age that is also not significantly biased against smaller forms (Wilf and other 1998); and (3) include localities that are closely tied with plant fossils allowing the study of mammalian evolution as it ties with climatic evolution.

Paleontology Ranking

The BLM considers the Wasatch and Green River Formations to be Class 5 paleo formations meaning they are highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant nonvertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts. The BLM considers the Fort Union Formation to be a Class 3 paleo formation, which means it is a fossiliferous sedimentary geologic unit where fossil content varies in significance, abundance, and predictable occurrence.

Class 5 paleo requires mitigation of ground disturbing activities. Class 3 paleo formations require sufficient mitigation to determine whether significant paleoresources occur in the area of the proposed action.

3.2 CLIMATE AND AIR QUALITY

3.2.1 Climate

The CRPA is located in a semiarid mid-continental climate regime typified by dry windy conditions, limited rainfall, and long cold winters. The elevation across the project area ranges from 7,000 feet to in excess of 7,600 feet, resulting in a relatively cool climate. In the wintertime, it is characteristic to have rapid and frequent changes between mild and cold spells.

The nearest National Weather Service (NWS) meteorological measurements were recorded at Bitter Creek, Wyoming (1962 to present). The Bitter Creek station is located approximately 20 miles northeast of the project area at an elevation of 6,720 feet (Western Regional Climate Center, 2003).

The annual mean precipitation at Bitter Creek is 6.72 inches, and ranges from a minimum of 2.59 inches recorded in 1988, to a maximum of 9.44 inches recorded in 1965. March is the driest month with an annual mean precipitation of 0.29 inches, and May is the wettest month with an annual mean of 1.15 inches. The annual average snowfall is 19 inches, with December, January and February being the snowiest months. A maximum snowfall of 34.5 inches was recorded in 1991.

The area is typically cool, with an annual mean temperature of 41.5 °F. Average winter temperatures range from 21°F to 34°F, while summer temperatures range from 44°F to 81°F. Recorded extreme temperatures are - 46°F in 1971 and 103°F in 1969.

The nearest comprehensive wind measurements are recorded at the Rock Springs, Wyoming airport, approximately 25 miles northwest of the project area. Winds originate predominately from the west to southwest 53 percent of the time, with an average wind speed of nearly 12 miles per hour (5.33 meters/second). Figure 3-2 presents a wind rose for the Rock Springs Airport for the years 1991 through 1995.

The frequency and strength of the wind greatly affects the transport and dispersion of air pollutants. The potential for atmospheric dispersion is relatively high for the project area due to the high frequency of strong winds. However, calm periods and nighttime cooling may enhance air stability, thereby inhibiting air pollutant transport and dilution.

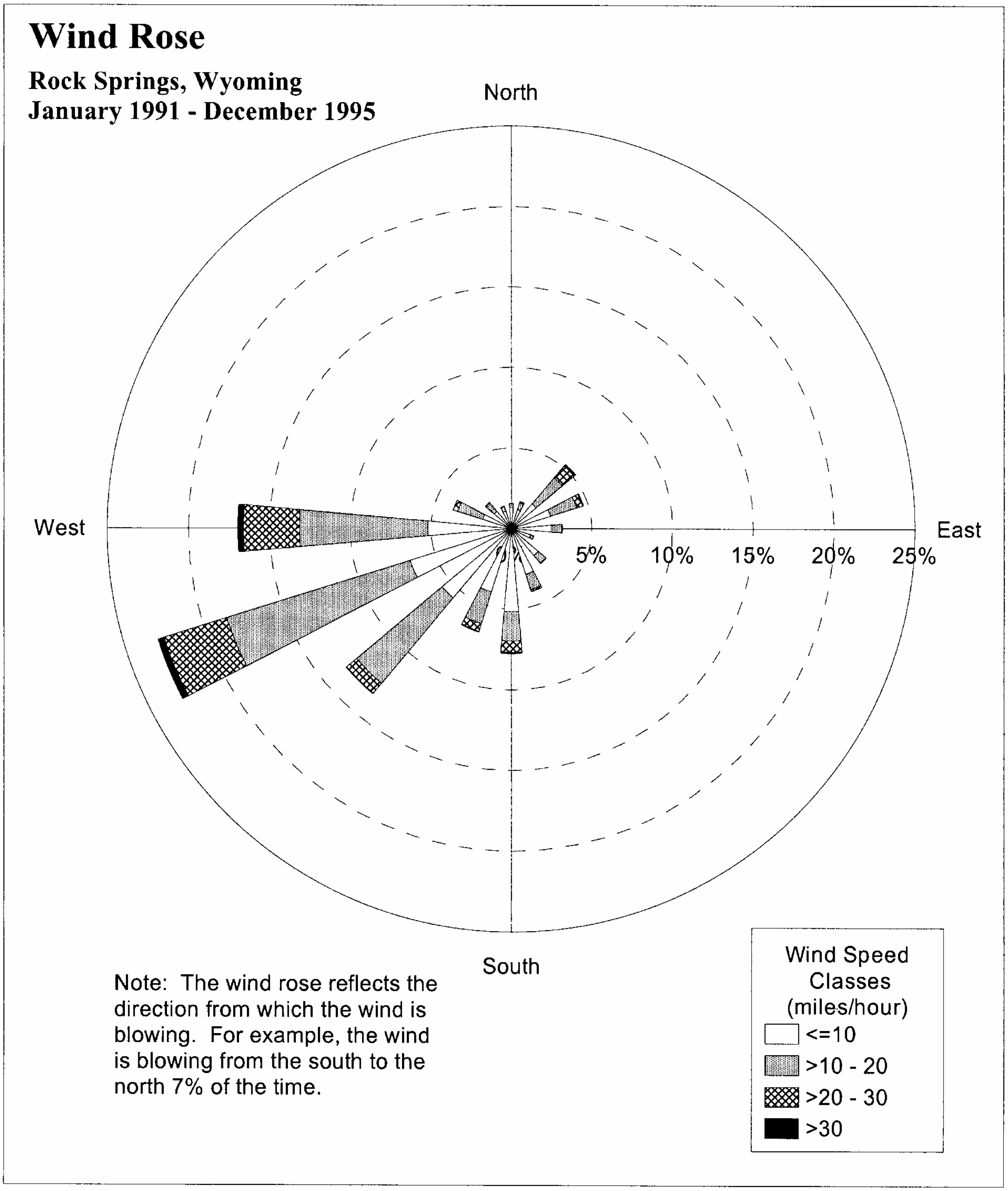
3.2.2 Air Quality

Specific air quality monitoring has not been conducted within the project area. However, air quality is expected to be relatively good due to the limited number of large industrial emission sources and predominately favorable atmospheric dispersion conditions. Industrial sources in the southwest quadrant of Wyoming include five large trona plants, several gas processing plants, two coal-fired power plants, numerous oil and gas production facilities and associated natural gas compressor stations (Wyoming Department of Environmental Quality, 2003).

Within the CRPA, the Wyoming Department of Environmental Quality – Air Quality Division (WDEQ-AQD) has primacy for implementing the Federal Clean Air Act and the permitting of air emission sources. Therefore, emission sources proposed under this action are subject to state permitting requirements including the application of Best Available Control Technology (BACT).

National and Wyoming Ambient Air Quality Standards (NAAQS and WAAQS) have been promulgated for the purpose of protecting human health and welfare with an adequate margin of safety. Pollutants for which standards have been set include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and particulate matter less than 10 or 2.5 microns in effective diameter (PM_{10} and $PM_{2.5}$). While no pollutant monitoring data are available for the project area, background values recorded in the region are below the NAAQS and WAAQS. Measured regional background concentrations are presented in Table 3-3 with the applicable ambient air quality standards.

Figure 3-2. Rock Springs, Wyoming Wind Rose



Under the Prevention of Significant Deterioration (PSD) provisions, incremental increases of specific pollutant concentrations are limited above a legally defined baseline level. Many national parks and wilderness areas are designated as PSD Class I. The PSD program protects air quality within Class I areas by allowing only slight incremental increases in pollutant concentrations. Areas of the state not designated as PSD Class I are classified as Class II. For Class II areas, greater incremental increases in ambient pollutant concentrations are allowed as a result of controlled growth. The PSD increments for both Class I and II areas are presented in Table 3-3.

The CRPA and surrounding region is federally designated as a PSD Class II area. The two nearest PSD Class I areas are Bridger and Fitzpatrick Wilderness areas located north of the project area. Contiguous with Bridger Wilderness are Pop Agie Wilderness and the Wind River Roadless Area, both designated as PSD Class II. Savage Run, a state designated PSD Class I area, is located east of the project area. Figure 3-3 presents a regional map indicating the location of the project area and the areas of special interest.

This NEPA analysis compares potential air quality impacts from the proposed Alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts, and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. For a new source review air quality permit application for a major source, the applicable air quality regulatory agencies may require a regulatory PSD increment analysis. More stringent emission controls beyond Best Available Control Technology may be stipulated in the air quality permit if impacts are predicted to be greater than the PSD Class I or II increments.

Areas of special concern, including some Class I and II wilderness areas, are monitored for Air Quality Related Value (AQRV) impacts. These AQRVs include wet and dry acid deposition, visibility and changes in lake acid neutralization capacity (ANC).

Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area (kilograms per hectare). Air pollutants are deposited by wet deposition (precipitation) and by dry deposition (gravitational settling of particles and adherence of gaseous pollutants).

Wet Deposition

The **N**ational **A**tmospheric **D**eposition **P**rogram (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). The NADP station closest to the Copper Ridge project area is near South Pass City, Wyoming, northwest of the CRPA. Data are available from 1985 through 2000.

The mean annual precipitation pH in South Pass City ranges from 4.7 to 5.1. The natural acidity of precipitation is considered to range from 5.0 to 5.6 pH (Seinfeld, 1986).

Table 3-3. Air Pollutant Background Concentrations, National and State Ambient Air Quality Standards, and PSD Increments

Pollutant And Averaging Time	Measured Background Concentration ($\mu g/m^3$)	National and Wyoming Ambient Air Quality Standard ($\mu g/m^3$)	PSD Class I Increment ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)
Carbon Dioxide (CO)				
1-hour	2,299 a	40,000	n/a	n/a
8-hour	1,148 a	10,000	n/a	n/a
Nitrogen Dioxide (NO_2)				
Annual	3.4 b	100	2.5	25
Ozone (O_3)				
1-hour	169 c	235	n/a	n/a
8-hour	147 c	157	n/a	n/a
Particulate Matter (PM_{10})				
24-hour	47 d	150	8	30
Annual	16 d	50	4	17
Particulate Matter ($PM_{2.5}$)				
24-hour	15 d	65	n/a	n/a
Annual	5 d	15	n/a	n/a
Sulfur Dioxide (SO_2)				
3-hour	29 e	1,300	25	512
24-hour (National)	18 e	365	5	91
24-hour (Wyoming)	18 e	260	5	91
Annual (National)	5 e	80	2	20
Annual (Wyoming)	5 e	60	2	20

Note: Measured background ozone concentration value represents the top tenth percentile maximum 1-hour value. Other short-term background concentrations are second-maximum values.

n/a: Not Applicable.

Wyoming Ambient Air Quality Standards from: Wyoming Air Quality Standards and Regulations, Chapter 2 - Ambient Standards.

National Ambient Air Quality Standards from: 40 CFR part 50 National Primary and Secondary Air Quality Standards.

PSD Increments from: 40 CFR part 51.166 Prevention of Significant Deterioration of Air Quality.

Sources of Measured Background Concentrations

a Data collected at Rifle and Mack, Colorado in conjunction with proposed oil shale development during the early 1980's (CDPHE-APCD 1996)

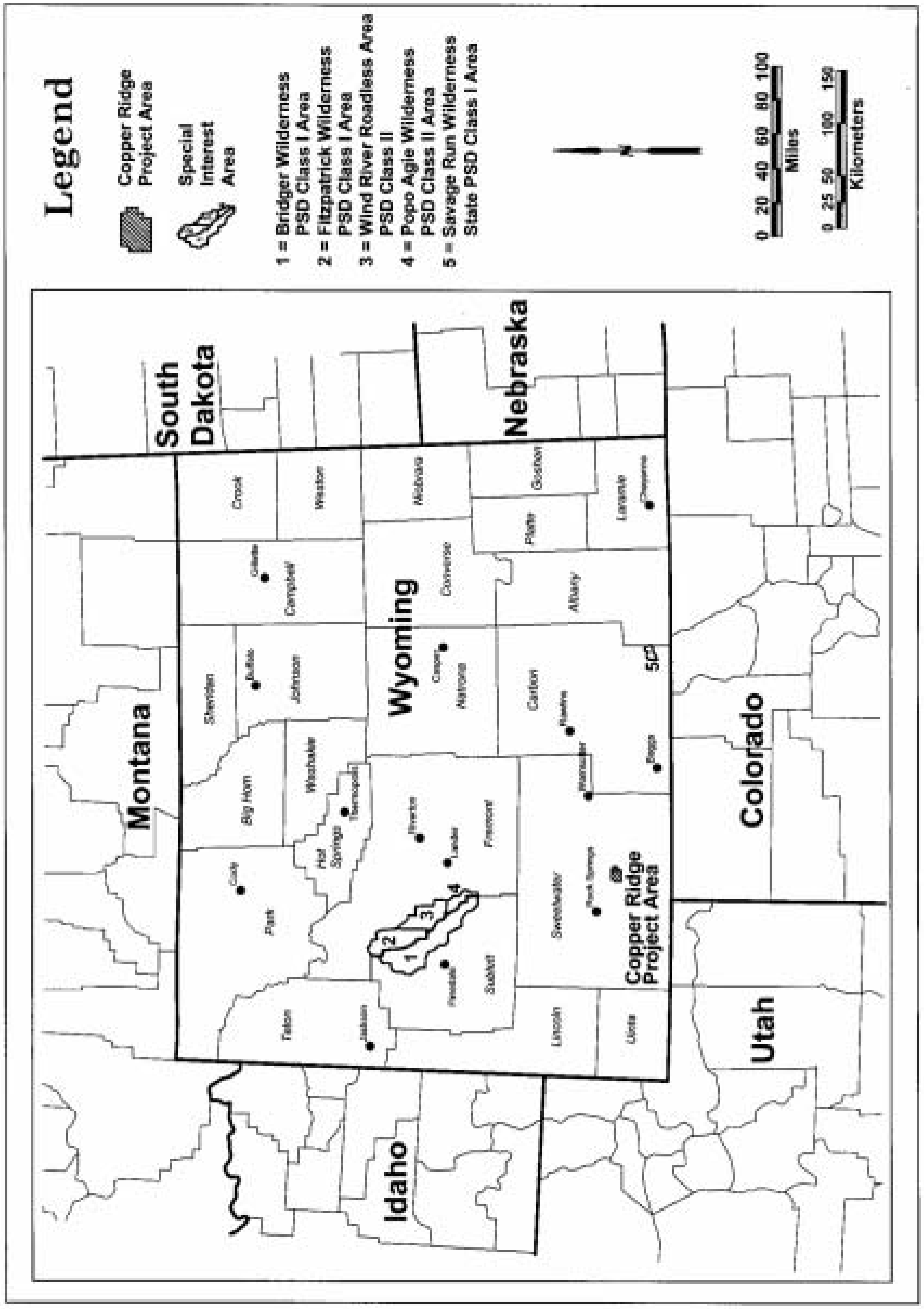
b Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period January-December 2001. (ARS, 2002)

c Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period June 10, 1998 through December 31, 2001 (ARS, 2001).

d Data collected at the Emerson Building, Cheyenne, WY during 2002 (WDEQ, 2003).

e Data collected at the Crain Power Plant site and at Colorado Oil Shale areas from 1980 to 1984. (CDPHE-AQCD 1996)

Figure 3-3. Copper Ridge Project Area and Nearest PSD Class I Areas



Wet deposition of nitrogen compounds near South Pass City include ammonium ($NH4^+$) deposition of .5 kg/ha, nitrate (NO_3^-) deposition of 1.75 to 4.5 kg/ha, and inorganic nitrogen deposition of .75 to 2 kg/ha.

Dry Deposition

The **C**lean **A**ir **S**tatus and **T**rends **Net**work (CASTNet) measures dry deposition of nitrogen and sulfur compounds. The CASTNet station nearest to the CRPA is near Pinedale, Wyoming, northwest of the CRPA. Data are available from 1992 through 1999.

Dry deposition of nitrogen compounds near Pinedale include ammonium ($NH4^+$) deposition of .08 to .13 kg/ha, nitrate (NO_3^-) deposition of less than .1 kg/ha, and nitric acid (HNO_3) deposition of 1.2 to 2.2 kg/ha.

Total Deposition

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet and dry deposition. Total deposition guidelines have been estimated for several areas, including the Bridger Wilderness in Wyoming (USFS, 1989). Estimated total deposition guidelines include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total deposition). Total nitrogen deposition guidelines for Bridger include a red line set at 10 kg/ha/year, and a green line set at 3-5 kg/ha/year.

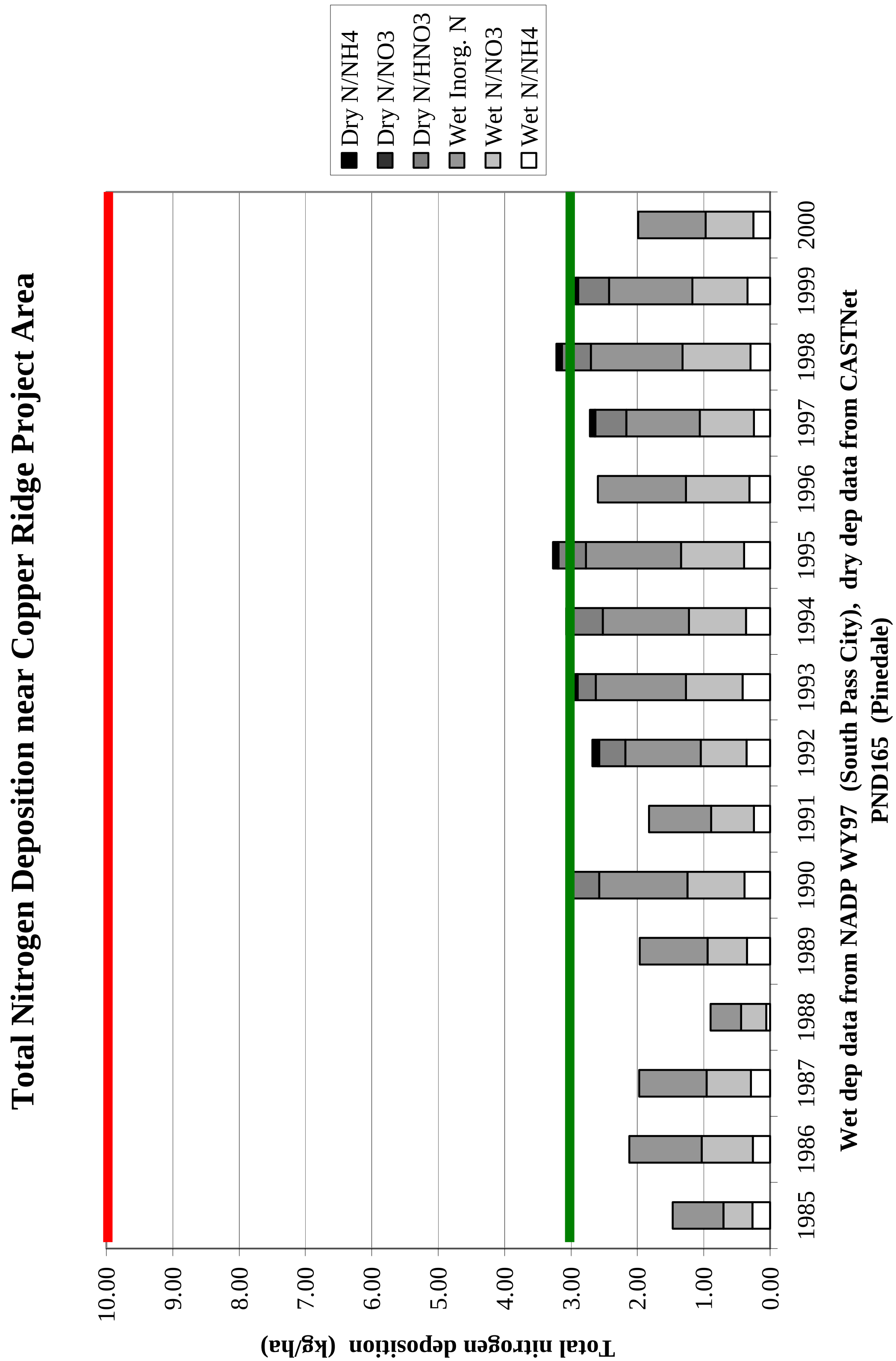
Total nitrogen deposition near the CRPA has been close to the Bridger Wilderness lower green line (3 kg/ha) from 1985 through 2000. Figure 3-4 presents a chart of the South Pass City and Pinedale deposition data along with the Bridger "red line" and lower "green line." Please note that wet deposition data are available from 1985 through 2000, while dry deposition data are available only from 1992 through 1999.

Visibility

Visitors to national parks and wilderness areas list the ability to view unobscured scenic vistas as an important part of a satisfying experience. Unfortunately, visibility impairment has been documented in many Class I areas. Most visibility impairment is in the form of regional haze. In the intermountain west, atmospheric sulfate, organics and elemental carbon are the main cause of regional haze and visibility impairment (FLAG 1999).

Visibility impairment is expressed in terms of deciview (dv). The deciview index was developed as a linear perceived visual change. A change in visibility of 1.0 dv represents a "just noticeable change" by the average person under most circumstances. Increasing deciview values represent proportionately larger perceived visibility impairments. The U.S. Forest Service (USFS) has identified specific "Level of Acceptable Change" (LAC) values that they use to evaluate potential air quality impacts within their wilderness areas (USDA-FS 1993). The USFS utilizes a visibility LAC threshold of 0.5 deciview.

Figure 3-4. Total Nitrogen Deposition near Copper Ridge Project Area



Visibility related background data collected as part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program are available for the Bridger Wilderness area. Visibility conditions at Bridger Wilderness are typically very good with an average annual visual range of 109 miles (IMPROVE 2000).

Acid Neutralization Capacity

Aquatic bodies such as lakes and streams are important resources in most Class I areas. Acid deposition resulting from industrial emissions of sulfur and nitrogen based compounds may have a direct effect on the acid neutralization capacity (ANC) of sensitive lake ecosystems. Screening methodologies involving comparisons of sulfate and nitrate deposition fluxes to changes in background ANC values have been applied in New Source Review and NEPA processes to predict air pollution caused changes to the chemistry of sensitive lakes (USDA – Forest Service 2000). The following table (3-4) summarizes the background ANC values for selected lakes located in areas of special concern.

Table 3-4. Background Acid Neutralization Capacity for Sensitive Lakes

Lake Name	Special Concern Area	Managing Agency	Background ANC Concentrations (µeq/l)
Black Joe	Bridger Wilderness	USFS	69.0
Deep	Bridger Wilderness	USFS	61.0
Hobbs	Bridger Wilderness	USFS	68.0
Upper Frozen	Bridger Wilderness	USFS	5.8
Ross	Fitzpatrick Wilderness	USFS	61.4
Lower Saddlebag	Popo Agie Wilderness	USFS	55.5

3.3 SOILS

3.3.1 Topography

The topography within the project area varies from nearly flat alluvial bottom lands in and bordering the drainages of Black Butte Creek, Burley Draw, Sand Wash, and Alkali Wash, to steep, along the western exposed edges of east-southeast-dipping hogbacks of the middle Eocene Green River Formation. Between these extremes are subdued ridge and valley badland exposures of the Paleocene Fort Union Formation, sharper and steeper badlands of the lower Eocene Wasatch Formation, as well as, broad areas of gently sloping residual uplands. Relief within the study area is 730 feet, with a low elevation of 6970 feet along Black Butte Creek in the NW1/4 NW1/4 Section 34, T17N, R101W, and a maximum elevation of 7700 feet in the NE1/4 NE1/4 Section 5, T16N, R100W.

3.3.2 Soils

3.3.2.1 General Soil Characteristics

Soils within the project area are distributed according to differences in parent material, elevation, moisture, and topographic slope and position. They are primarily included in the Torriorthents-Camborthids-Haplargids association that formed under a dry, cool (frigid) climate with spring moisture. Soils of this association have low organic matter and are formed from residuum on Tertiary bedrock-controlled uplands and in Quaternary alluvium and colluvium along stream courses.

Most of the soils in the project area are developed on shales, mudstones, and sandstones of Tertiary age (Fort Union Formation, Wasatch Formation, and Green River Formation), and on alluvium locally derived from those rocks. A subsidiary but very important component of the soils, consists of fine-grained aeolian (wind-blown) sand that either has become mixed with deeply weathered bedrock, or occurs as patches of dune sand stabilized by vegetation.

Streams draining the project area all originate in areas of easily weathered and eroded bedrock sandstone, shale, and mudstone, and thus accumulations of gravel are practically nonexistent, except in the floors of those stream reaches that are proximal to outcrop. The few benches in the area that appear to have formed through stream erosion lack gravels and appear to be rock-cut (bedrock) terraces.

Geomorphic Setting, Soil Texture and Slope

In the absence of baseline soils information field investigation was utilized to gather site-specific data on soil characteristics grouped according to geomorphic landform. Five broad categories are recognized in the project area and include: (1) Alluvial Bottom, (2) Upland Slope, (3) Residual Colluvial areas, (4) Stabilized Sand Dunes, and (5) Outcrop (Figure 3.xxx).

Soil textures consist primarily of sandy loams, sandy clay loams, clay loams, and sandy clays, and are best developed in Alluvial Bottomland Soils and Upland Slope Soils-the soils which occur in areas with minimal slope. Residual Colluvial Soils are formed on steeper slopes and consist of slope washed parent materials, including angular blocks of sandstone and shale debris mantling their source rocks. Outcrop consists of bare exposed rock that has not undergone any appreciable soil development. Remnants of Stabilized Sand Dunes are usually developed on gently sloping surfaces otherwise covered by the Upland Slope Soils. These dune remnants are dominantly composed of fine sand.

Soil covered slopes within the project area vary from 0-2% on Alluvial Bottomland Soils, to 0-55% on Outcrop (short cliff faces are developed in limestones in the Green River Formation). Upland Slope Soils show slopes of 0-10%, whereas Residual Colluvial Soils vary from 5-15% in slope. Slopes of Rock Outcrop vary from gentle to nearly vertical.

Soil Depth

All soils in the Copper Ridge Unit project area are shallow (less than 60 cm in total thickness), their combined A (top) and B (subsurface) horizons measuring from only 15 to 44 cm in thickness. The thickest soils are the Alluvial Bottomland Soils (27-44 cm depth), and the thinnest (excluding Residual Colluvial Soils) are the Upland Slope Soils (15-19 cm depth). In test pits, nearly all the Alluvial Bottomland Soils and Upland Slope Soils exhibit effective rooting into the top of the C (unweathered parent material) horizon.

Soil Permeability and Erosion Potential

The majority of soils in the project area are moderately permeable due to their mixed sand and clay compositions. In the more highly clay-rich subsurface parts of the soils, permeability is diminished. The surfaces of most of the soils are quite sandy and thereby show relatively rapid permeability; however, all of these soils will become less permeable upon compaction.

Alluvial (stream) and aeolian (wind) erosion potential is a function of soil texture which, in turn, is related to degree of soil development on differing parent materials. Clay-rich soils or clay-rich soil horizons have relatively low erosion potential due to their low permeability but they are subject to surface collapse because of the high absorptive properties of the clay minerals which, when wetted and dried, form puffy surface crusts. Sand-rich soils are more easily eroded by both water and wind, especially in places where the vegetation cover is scant or absent.

The presence of small areas covered by Stabilized Sand Dunes and the high percentage of aeolian (wind-blown) sand-especially prevalent in the Upland Slope Soils-is indicative of both active erosion and deposition of soil materials by wind during the time of soil formation. However, appreciable wind erosion of soils in the project area is unlikely unless the natural vegetation cover is substantially reduced.

Stream erosion due to runoff, bank collapse, and piping is common in and near drainages with deeply incised channels, as seen in Alluvial Bottomland Soils. Shallow gullying was also seen on rutted dirt roads on which the ruts had penetrated the relatively permeable A (upper) horizon of the soil and had exposed the more impermeable clay-enriched B (subsurface) soil horizon. Erosion may be accelerated by surface disturbance such as the blading off vegetation and of the very shallow yet more permeable A horizons of the soils. However, because all soils in the project area are shallow (less than 60 cm depth-maximum 45 cm), it is probable that most blading will completely remove the topsoil and expose bedrock. Exposed bedrock (*Outcrop*) is generally less susceptible to erosion than are the soil veneers, but much of the Fort Union, Wasatch, and Green River formations are comprised of clay-rich mudstones and shales that become exceedingly muddy after even minimal rainfalls. Therefore, runoff potential is low on most of the area of undisturbed soils in the project area, but can be expected to increase to moderate/high with surface disturbance of soils. Exceptions are where soil slopes are relatively steep, or the soils are proximal to gullies.

3.3.2.2 Site Specific Soil Characterizations

Site-specific field investigation of soils in the CRU were undertaken to determine soil characteristics such as developing horizons, texture, color, permeability, and topographic distribution. The five soil types distinguished during this study include: (1) Alluvial Bottomland Soils; (2) Upland Slope Soils; (3) Residual Colluvial Soils; (4) Stabilized Sand Dunes; and (5) Outcrop.

Alluvial Bottomland Soils

This type of soil is developed over about 10% of the project area and is confined to locations with low slopes immediately adjacent to the larger principal drainages. Soils of this type are shallow and formed on alluvial parent materials derived from local outcrops of sandstones, shales, and mudstones of the Fort Union, Wasatch, and Green River formations. Four examples of Alluvial Bottomland Soils are developed as follows:

Site CPSO1

UTM 12: 685747E, 4577529N; slopes = 0-1%; permeability moderate with low runoff except near drainages.

A = Slightly calcareous sandy clay loam with blocky to slightly platy texture; 4 cm.

Bt = Calcareous sandy clay with platy texture; 10YR6/3 (pale brown); 40 cm.

C= Deeply weathered sandy mudstone of Wasatch Formation; faintly bedded; calcareous.

Site CPSO2

UTM 12: 682933E, 4579982N; slope = 0-1%; permeability moderate with low runoff; erosion potential low except near drainages where piping may occur.

A = Moderately calcareous and granular sandy loam; 6 cm.

Bt = Calcareous sandy clay loam; 2.5Y6/3 (light yellowish-brown); 23 cm.

Btk = Sandy clay loam with rare filaments of $CaCO_3$; much harder than Bt horizon and with lighter color (2.5Y7/3 = pale yellow); 20 cm.

Site CPSO4

UTM 12: 686530E, 4583716N; slope approximately 0%; moderate permeability with low runoff potential; erosion potential great as site lies proximal to gullied drainage system.

A = Moderately calcareous sandy clay loam; granular, loose, friable; 3-4 cm.

Bt = Very calcareous clay loam; 10YR5/4 (yellowish-brown); no visible $CaCO_3$; 29 cm.

C = Parent alluvium with thin bedding preserved; moderately calcareous.

Site CPSO5

UTM 12: 687450E, 4585684N; slope = 0-2%; highly permeable with low runoff and erosion potential.

A = Sandy loam, friable (probably some aeolian component); 3 cm.

Bt = Slightly calcareous sandy clay loam; pH = 7.0; 10YR4/4 (dark yellowish-brown); 24 cm.

Ck = Weathered sandy mudstone of Wasatch Formation; highly calcareous.

Upland Slope Soils

Upland Slope Soils are developed over approximately 35% of the project area and are the dominant features of flat to gently sloping (0-10% slopes) lands lying between the alluvial bottomland areas and exposures of *Residual Colluvial Soils* and *Outcrop*. Soils of this type are very shallow and formed on a parent material consisting of mixed weathered rock, slopewashed mud and clay, and aeolian (wind-blown) sand. The following description of an Upland Slope Soil is typical:

<u>Site CPSO3</u>

UTM 12: 684000E, 4583152N; slope about 3%; permeability moderate to high with low runoff potential and low erosion potential, except where gullying might be instigated by loss of vegetation.

> **A** = Residual clay fragments, paleosol calcrete glaebules, and sandstone granules of deeply weathered Wasatch Formation mixed with aeolian sand; 4 cm.
>
> **Bw** = Very calcareous sandy loam; 2.5Y6/3 (light yellowish-brown); pH = 6.5; no visible CaC03 filaments or pisoliths; 15 cm.
>
> **Cox** = Weathered clay balls and paleosol calcrete glaebules of Wasatch Formation.

<u>Stabilized Sand Dunes</u>

Stabilized Sand Dunes form a veneer over other surface soils in about 1% of the survey area, although their distribution might be somewhat greater due to the high percentage of sand of apparent aeolian origin in both Alluvial Bottomland Soils and Upland Slope Soils. The dunes generally blanket moderate 0-10% slopes otherwise marked by the development of Upland Slope Soils. The dunes are generally less than a few feet in thickness and trend more-or-less WSW-ENE or SW-NE. Because of their high sand content, the dunes are highly permeable and are unlikely to be an erosion problem unless dune fields are stripped of their dominantly sagebrush cover.

<u>Residual Colluvial Soils</u>

This soil type occupies about 9% or less of the project area, where it is found adjacent to Outcrop on slopes of approximately 5-15%. Colluvial cover consists of slopewashed shale and mudstone, as well as, varying amounts of angular sandstone blocks of pebble to boulder size. Because of the relatively high slopes, Residual Colluvial Soils might be subject to small to massive slumping, earthflow, and creep, and are therefore unstable and highly erodable, although no areas of mass movement are mapped or noted in the area.

<u>Outcrop</u>

Outcrop includes exposed bedrock of the Fort Union, Wasatch, and Green River formations. The Fort Union and Wasatch are characterized by mudstones of varying colors interbedded with about 20% sandstone, and supported with minor amounts of lignite, lignitic mudstone, and limestone concretions and nodules. In the report area, the Green River Formation is volumetrically dominated by shale and sandy shale, with less important amounts of sandstone and thin units of bedded limestone. The sandstones and limestones are quite resistant to stream and aeolian erosion; however, the mudstones and shales are susceptible to minor to severe gullying and badland development, especially where they form steep slopes on the fronts of hogbacks. Outcrop forms slopes of 0-55%, and makes up the surface of approximately 45% of the Copper Ridge Unit project area.

3.4 WATER RESOURCES

Water resources in the project area include both surface water and groundwater. Surface water resources include numerous ephemeral streams and a few shallow ponds that are both natural and man-made. The project area lies entirely within the Bitter Creek watershed. Bitter Creek, an intermittent to ephemeral stream, is a major tributary to the Green River in the Colorado River watershed. Headwaters of ephemeral tributaries of Bitter Creek originate in the project area. The named tributaries are Black Butte Creek, Sand Wash, Burley Draw, Cedar Draw, and Polly Draw. Sand Wash is a tributary of Black Butte Creek. Burley Draw, Cedar Draw, and Polly Draw are tributaries to Alkali Wash, which is tributary to East Salt Wells Creek, which is a tributary of Salt Wells Creek. Salt Wells Creek, an intermittent stream, is a tributary of Bitter Creek. Some unnamed ephemeral tributaries of Patrick Draw also occur in the northeastern portion of the project area. Patrick Draw is also an ephemeral tributary of Bitter Creek. No naturally occurring seeps or springs occur within the project area. Groundwater resources include free water contained within relatively shallow aquifers that are or could be used for domestic, agricultural and/or industrial purposes. The occurrence and distribution of water resources in the project area are dependent on climate, soils, and structural geology (Geology Section 3.1).

3.4.1 Precipitation

Mean annual precipitation is expected to be approximately seven to eight inches in the project area, with Bitter Creek and Rocks Springs Airport stations having an annual average of 6.72 inches and 9.03 inches, respectively. Precipitation is somewhat evenly distributed throughout the year with a peak in May. At Bitter Creek, the average monthly precipitation for the month of May is 1.15 inches. At the Rock Springs Airport, the average monthly precipitation for the month of May is 1.21 inches (WRCC 2003). The majority of precipitation falls as rain from frontal systems and thunderstorms. Concerning intensity of rainfall events, the 50-year, 24-hour precipitation rate is 2.4 inches (Miller et al. 1973). Mean snowfall depth for the year is greater at the Rock Springs Airport (about 45 inches) than further east at Bitter Creek (about 19 inches). The greatest snowfall occurs in December and January at Bitter Creek and in March at the Rock Springs Airport (WRCC 2003). Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter.

<u>Other Climate Characteristics</u>. Mean annual evaporation ranges from 50 inches (lake) to 70 inches (pan) and annual potential evapotranspiration is roughly 21 inches (Martner 1986). Compared to the mean annual precipitation of eight inches, this gives a mean annual water balance deficit of approximately 13 inches. The project area is subject to strong, gusty winds. Comprehensive wind measurements are collected at the Rock Springs Airport. The prevailing wind is from the west and southwest at an average of about 12 miles per hour. Violent weather is relatively common in the area; thunderstorms occur an average of 30 days per year and hail an average of three days per year. These meteorological and climatological characteristics of the project area combine to produce a predominantly dry, cool, and windy climate punctuated by quick, intense precipitation events.

3.4.2 Surface Water

3.4.2.1 Surface Water Quantity

Numerous ephemeral stream channels, both named and unnamed (see Figure 3-5), occur within the project area. Typically, under this flow regime, streamflow will last for only a brief period of time following a runoff-producing snowmelt or precipitation event. The project area falls entirely within the Bitter Creek drainage basin (USGS Basin #14040105) and is located approximately seven miles south of the Bitter Creek channel at its closest point. Bitter Creek is considered an intermittent stream that carries water most of the time over most of its course, although there are periods of no flow, especially during fall and winter. Most flow occurs in the spring during snowmelt or after storm events. The Bitter Creek watershed (2,207 square miles) discharges into the Green River near the town of Green River, Wyoming. The Green River flows into the Colorado River, which ultimately flows to the Pacific Ocean.

The project area overlies the following twelfth-order watersheds: Patrick Draw (140401050204) containing 23,145 acres, Upper Black Butte Creek (1401050401) encompassing 29,749 acres, Big Flat Draw (140401050609) having 1,241 acres, Lower Salt Wells Creek (140401050607) containing 24,516 acres, and Polly Draw (140401050608) with 18,814 acres. Black Butte Creek and its named tributary Sand Wash drain the northern and eastern portion of the project area. Alkali Wash and its named tributaries Burley Draw, Cedar Draw, and Polly Draw are all within the Lower Salt Wells Creek watershed and drain the southern and western portion of the project area. Tributaries of Patrick Draw drain a small part of the northeastern corner of the project area. There are no internally drained areas in the project area.

A few naturally occurring, shallow, ponds exist along the Sand Wash channel in Sections 11 and 12, T16N, R101W. Water levels in these ephemeral ponds are erratic and typically fluctuate in response to the frequency of runoff events. The source of water for these ponds appears to be primarily from surface runoff as there are no springs or seeps located upstream. There are also some small ponds that were constructed to contain water produced from existing gas wells within the project area (Figure 3-4). No springs or flowing wells have been identified within the project area.

Flow within the stream channels correlates directly with precipitation; surface runoff occurs during spring and early summer as a result of snowmelt and rainfall (Lowham et al. 1985). Based on the peak flow records from the U.S. Geological Survey's crest gage station 09216560 (located on Bitter Creek near Point of Rocks, Wyoming), the most probable month for peak runoff is April (BBCC 1998). Streams receive little to no support from groundwater discharge to sustain flow; consequently, there are extended periods of time when stream channels are dry. Active stream channels in the project area exhibit ephemeral flow only during snowmelt and high-intensity, short-duration summer thunderstorms. Rainstorm runoff can cause large peak flows, although the duration of flow from rainfall is relatively short in comparison to snowmelt runoff. Because precipitation varies from year to year, runoff volumes vary as well.

Within the general vicinity of the project area, runoff frequency may be insufficient to maintain active stream channels. Most of the small, lower-order stream channels that are identified on 7.5-minute USGS topographic maps are more accurately described as vegetated swales and lack active channels. Specific stream courses may grade between active channels and vegetated swales along their length. Similarly, some of the larger, higher-order streams such as

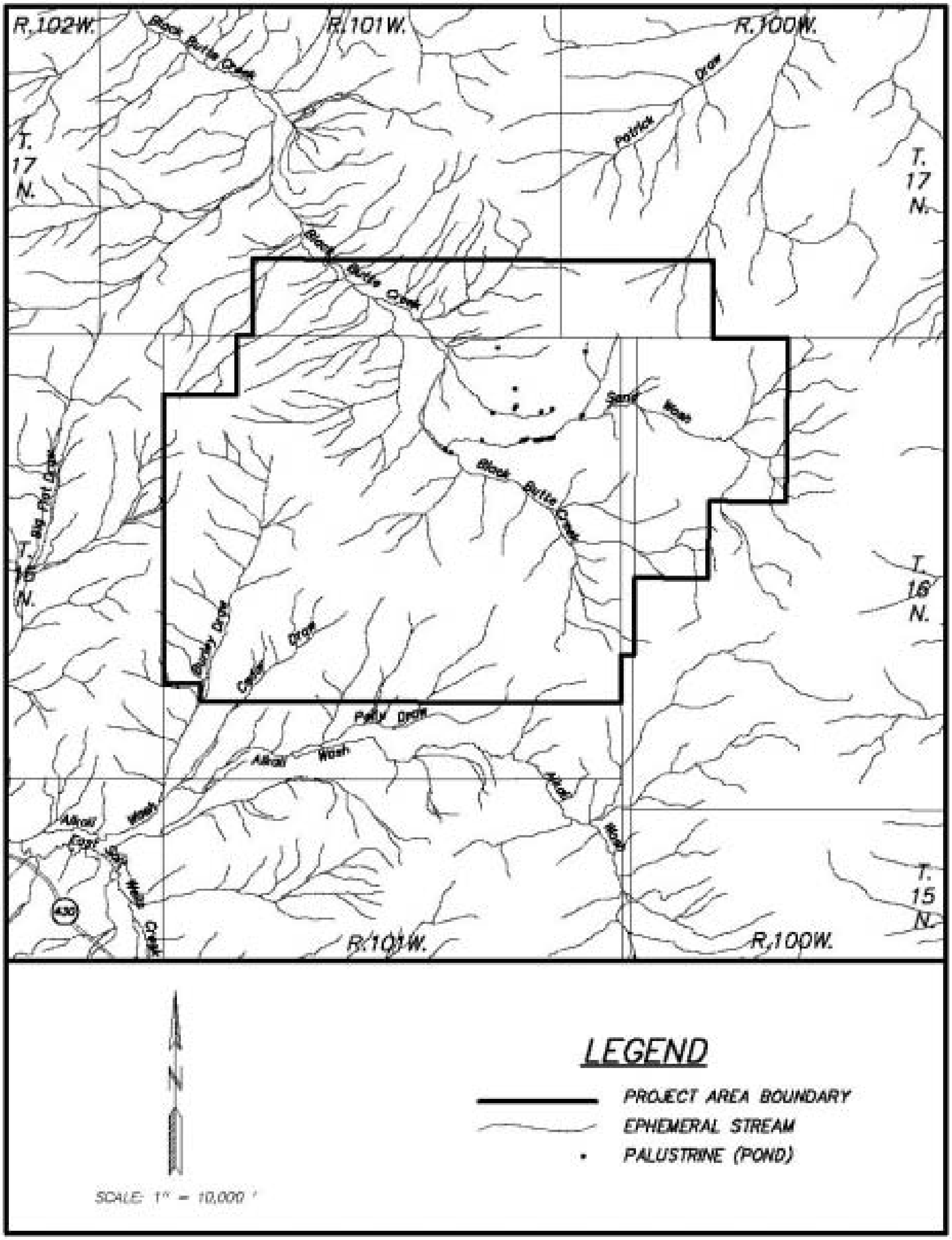


Figure 3-5. Surface Water Features in the CRPA.

Bitter Creek may exhibit intermittent flow in one section of the channel and ephemeral flow in another section.

There are no USGS surface water gaging stations within the project area. The closest USGS streamflow gaging stations are located on Bitter Creek, Salt Wells Creek, and Big Flat Draw (a tributary of East Salt Wells Creek). Historical streamflow data recorded on these streams (USGS 2003) are as follows:

- USGS Station 09216545, Bitter Creek near Bitter Creek, Wyoming, was maintained from 1975 through 1981. This site was located immediately upstream of the Patrick Draw confluence and, therefore, is upstream of any runoff contribution from the project area. The mean annual streamflow recorded at this location ranges from 1.5 cubic feet per second (cfs) (in 1976) to 11.2 cfs (in 1980). Instantaneous peak discharges recorded at this site range from 75 cfs (in 1981) to 346 cfs (in 1980).

- USGS Station 09216562, Bitter Creek Above Salt Wells Creek Near Salt Wells, Wyoming, was maintained from 1975 through 1981. The mean annual streamflow recorded at this location on Bitter Creek, which was downstream of the Black Butte Creek confluence and upstream of the Salt Wells Creek confluence, ranges from 3.6 cfs (in 1978) to 15.7 cfs (in 1980). Instantaneous peak discharges at this site ranged from 280 cfs (in 1980) to 888 cfs (in 1979).

- USGS Station 09216750, Salt Wells Creek Near Salt Wells, Wyoming, was maintained from 1975 through 1981. This site was located upstream of Salt Wells Creek’s confluence with Bitter Creek. The mean annual flow recorded at this location ranges from 1.99 cfs (in 1978) to 8.10 cfs (in 1980). Instantaneous peak discharges at this site ranged from 87 cfs (in 1978) to 1,650 cfs (in 1976). Based on the five years of record obtained at this site, the average runoff for Salt Wells Creek is about 2,000 to 3,000 acre-feet per year (Lowham et al. 1982).

- The USGS maintained crest-stage gages at Station 09216700, Salt Wells Creek Near Rock Springs, Wyoming, from 1959 through 1976. This site was located roughly 10 miles upstream of Station 09216750. Instantaneous peak discharges at this site ranged from 75 cfs (in 1961) to 3,750 cfs (in 1962). A review of the weather records for the area indicates that flood event resulted from a rain on snow pack (Lowham et al. 1982).

- The USGS maintained crest stage gages at Station 09216580, (Big Flat Draw Near Rock Springs, Wyoming) from 1973 through 1981. A small portion of Big Flat Draw watershed, a tributary of East Salt Wells Creek, overlaps the western edge of the project area (Figure 3-3). Instantaneous peak discharges at this site, located at the mouth of Big Flat Draw, ranged from 11 cfs (in 1975) to 217 cfs (in 1979). Big Flat Draw has a drainage area of approximately 20 square miles.

Given the arid climate of the project area and the lack of well-established active channels, mean annual runoff (or watershed yield) is relatively low at less than 0.5 inch per year, or about 2.5 percent of the total annual precipitation (Wyoming Water Research Center 1990).

Runoff estimates prepared for the Bitter Creek watershed by the Black Butte Coal Company (BBCC 1998) indicate that the annual runoff from the Bitter Creek watershed will average between 4,000 and 8,000 acre-feet, which results in a unit runoff of 1.8 to 3.6 acre feet per square mile.

Based upon a recent (February 2003) review of the records, of the Wyoming State Engineer's Office (SEO) there is currently one active surface water right in the project area. This water right is associated with the Brady Gas Plant and permitted for miscellaneous use, the amount being unspecified and unadjudicated. One other surface water right existed within the project area, although it was a temporary right to use surface water that was hauled from Salt Wells Creek for oil and gas drilling.

3.4.2.2 Surface Water Quality

The surface water quality in the Green River drainage basin, in general, is addressed in several reports published by the USGS (i.e., DeLong 1977, DeLong and Wells 1988, Ringen 1984). A report published by the USGS on the hydrology of Salt Wells Creek (Lowham et al. 1982) provides surface water quality information that is more specific to the project area. Dissolved solids, suspended sediments, and salinity are the constituents that are primarily evaluated, as they are typically indicators for the evaluation of water for various uses. These reports also relate streamflow discharge to these constituents.

Surface water quality in semiarid regions is seasonal and dependent on the magnitude and frequency of discharge events, although the dissolved solids concentration typically increases in the downstream direction. During periods of little to no precipitation, evaporation and capillary action produce a salt residue on the surfaces of bedrock, soils, and channel deposits. Runoff from rainfall and snowmelt then periodically flushes the accumulated salts downstream. During high-intensity thunderstorm events, the dissolved solids concentration increases rapidly during the early period of runoff, but then will decrease after the initial flushing of salts has taken place. During less intense, low-flow events, the dissolved solids concentration generally increases in the downstream reaches. In streams where base flows are responsible for a very small part of overall streamflow, flushing of salts by floods appear to be the major mechanism by which dissolved solids are transported from the basin. The flushing action is a process that affects the quality of plains streams of southwestern Wyoming (Lowham et al. 1982). In less arid areas, less evaporation and more frequent flushing of accumulated salts would generally result in lower dissolved solids concentrations throughout the year.

Due to the erosive nature of the area, relatively high-suspended sediment concentrations are expected, particularly during high flow events. Ephemeral streams in the area also commonly exhibit very high suspended sediment concentrations during the first flows of a flood wave, apparently the result of a flushing action similar to the flushing of salts. During periods of several months or more without flow, basin surfaces and stream channels accumulate loose material due to weathering, wildlife and livestock movements, bank caving, and wind deposits. These loose materials are then readily picked up and transported (flushed) by the turbulent first flows of a floodwave. Once the initial flush has occurred, the amount of sediment transported is dependent upon supply (erosion) and magnitude of discharge (Lowham et al. 1982).

Although the amount of runoff from small ephemeral streams may be small in relation to that of the larger receiving streams (i.e., Salt Wells and Bitter Creek), the flushing process results in relatively large concentrations of dissolved and suspended materials that may constitute a shock load to receiving streams, particularly during low flow summer months. Runoff from arid and semiarid plains areas can therefore have an important affect on the water quality of the perennial streams (i.e., Green River) receiving such runoff (Lowham et al. 1982).

As indicated in the previous section, there are no established surface water quality sampling stations within the project area. The USGS (Lowham et al. 1982) reported increasing dissolved solids concentrations in the downstream direction are typical of Salt Wells Creek during runoff events, and that the total dissolved solids concentration at USGS Station 09216750 (Salt Wells Creek near Salt Wells, Wyoming) commonly exceeds 3,000 mg/L. Within the same USGS report, large concentrations (sometimes exceeding 100,000 mg/L) of total suspended solids (TSS), or sediment, result from the flushing phenomena. After the initial flush, TSS concentrations generally increase with increasing discharge. Flows in the late summer and early autumn tend to have high amounts of dissolved and suspended solids, evidence of the erosiveness of the system. Winter and early spring flows tend to have low sediment loads, as runoff often occurs over ice and snow (BBCC 1998).

The water quality of Bitter Creek was monitored by the USGS at Stations 09216545 (Bitter Creek near Bitter Creek, Wyoming) and 09216562 (Bitter Creek Above Salt Wells Creek Near Salt Wells, Wyoming) from 1975 through 1981 (USGS 2003). Streamflow recorded at these two sites was discussed above in Section 3.4.2.1. The following surface water quality conditions of Bitter Creek can be expected in the general vicinity of the project area:

- At site 09216545, the pH ranged from 7.8 to 9.3, the average pH was 8.58, and the median pH value was 8.5. The TDS concentration ranged from 280 to 4,500 mg/L, the average concentration was 1,755 mg/L, and the median concentration was 1,780 mg/L. The TSS concentration ranged from 22 to 21,900 mg/L, the average concentration was 1,843 mg/L, and the median concentration was 246.

- At site 09216562, the pH ranged from 7.6 to 8.8, while both the average and median pH values were 8.3. The TDS concentration ranged from 530 to 12,300 mg/L, the average concentration was 3,527 mg/L, and the median concentration was 2,860 mg/L. The TSS concentration ranged from 22 to 51,800 mg/L, the average concentration was 5,074 mg/L, and the median concentration was 635.

The USGS collected miscellaneous TSS samples at Station 09216580, Big Flat Draw Near Rock Springs, Wyoming, in 1976 and 1977. Instantaneous peak discharges recorded at this site from 1973 to 1981 are presented above in Section 3.4.2.1. The TSS concentrations ranged from 1,050 mg/L to 147,000 mg/L. Big Flat Draw streamflow recorded at the time these samples were collected was 0.05 cfs and 28 cfs, respectively.

Western Wyoming College collected a grab sample from East Salt Wells Creek at a location just upstream of the Salt Wells Creek confluence in August 1976 (WRDS 2003). The streamflow was 12 cfs, the pH was 7.8, the TDS concentration was 414 mg/l, and the TSS concentration was not analyzed. The BLM collected two grab samples from Black Butte Creek at a location approximately 15 miles downstream of the project area in April 1980 (WRDS 2003). The sample that was collected when the streamflow was reported to be essentially zero had a pH of 8.4, a TDS concentration of 1,520 mg/L, and a TSS concentration of 670 mg/L. The sample that was collected when the streamflow was reported to be 0.63 cfs had a pH of 7.8, a TDS of 230 mg/L, and a TSS concentration of 3,790 mg/L.

No other site-specific data are available. In general, the data that are currently available suggest that surface water quality in the project area is not suitable for domestic uses and is marginally suitable for agricultural and industrial uses, although should be suitable for wildlife and livestock watering. Surface water, when present in the project area, is expected to be of relatively poor quality due primarily to high dissolved solids, suspended sediment, and turbidity.

Point pollution sources have not been documented in the project area, and if they have occurred, they were probably accidental and of limited areal extent and of short duration. The primary non-point pollution source is natural erosion of geologic units, which are easily eroded. Grazing, oil and gas development, and poor road construction may further increase the high erosion rates described in the Soils Section (USDI-BLM 1999).

The Wyoming Department of Environmental Quality (WDEQ 2000) classifies Wyoming surface water resources according to quality and degree of protection. Four classes have been identified as follows:

Class 1. Those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of substantial quantities of developable water and other values of present and future benefit to the people.

Class 2. Those surface waters other than Class 1 determined to be presently supporting game fish or drinking water supplies or where these uses are attainable.

Class 3. Those surface waters, other than those classified as Class 1, that because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning. Class 3 waters provide support for invertebrates, amphibians or other flora and fauna that inhabit water at some stage of their life cycles. Generally, Class 3 waters have wetland characteristics, which are a primary indicator used in identifying Class 3 waters.

Class 4. Those surface waters, other than those classified as Class 1, where it has been determined that aquatic life uses are not attainable.

Bitter Creek is a Class 2 stream; Salt Wells Creek, East Salt Wells Creek, and Alkali Wash are all Class 3 streams as are Black Butte Creek and Patrick Draw. All other ephemeral streams in the project area (i.e., Sand Wash, Burley Draw, Cedar Draw, and Polly Draw) are undesignated and by default take on the classification of the first stream they run in to; therefore, they are all Class 3 streams.

The WGFD has also classified surface waters in regard to the quality of fishery habitat and/or the importance of fisheries provided by the surface water bodies. All streams within the Bitter Creek drainage basin are Class 5 streams (incapable of supporting trout) (WGFD 1991).

Salinity. A primary water quality concern is increased salinity levels in area surface waters. Salinity has been noted as a key factor that limits water use and is a concern relative to downstream water uses. Salinity has become a major concern within the Colorado River drainage basin. The 1972 Clean Water Act (CWA) required the establishment of numeric criteria for salinity for the Colorado River. In 1973, seven Colorado River basin states created the Colorado River Basin Salinity Control Forum. The Forum developed water quality standards for salinity including numeric criteria and a basin-wide plan of implementation. The plan consists of a number of control measures to be implemented by State and Federal agencies. In 1974, Congress enacted the Colorado River Basin Salinity Control Act. The Act was amended in 1984. The amendments required the Secretary of Interior to develop a comprehensive program to minimize contributions from lands administered by the BLM.

Moderately erosive and saline soils naturally occur within and around the project area. Saline soils are associated with parent material from sedimentary rocks of the Tertiary Green River and Wasatch Formations. Once the soil is disturbed (i.e., from construction of a road or well pad), the potential for the release of residual soil sediment is increased. It is possible that oil and gas activities in the general area have and will continue to contribute to both sedimentation and salinity levels presently being experienced in the Green River. All of the soils within the project area have the potential of creating water quality-related sediment and salinity problems when disturbed.

3.4.2.3 Waters of the U.S.

Most of the surface water features in the project area qualify as Waters of the United States. Waters of the U.S. include the territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and Department of Army Corps of Engineers (COE). As described previously, many of the drainage channels identified on the USGS topographic maps are vegetated swales, which are not considered to be waters of the U.S. by the COE. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the Wyoming SEO. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Section (Section 3.5).

3.4.3 Groundwater

Groundwater resources include deep and shallow, confined and unconfined aquifers. The project area occurs in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); and the Great Divide and Washakie basins described by Collentine et al. (1981) and Welder and McGreevy (1966). Site-specific groundwater data for the project area are limited, although some miscellaneous information from water wells located in the general vicinity are available from the Wyoming SEO (SEO 2003), the Wyoming Oil and Gas Conservation Commission (WOGCC 2003), and the Wyoming Water Resources Data System (WRDS 2003). Other sources of information on groundwater resources in the general area come from Lowham et al. (1982), which includes information on the quality of groundwater from different geologic units underlying the Salt Wells Creek drainage basin. In addition, groundwater resources in the general area of the Black Butte Coal Mine, a large-scale strip mining operation located between the project area and Point of Rocks, Wyoming, are included in Black Butte Coal Company's Wyoming Department of Environmental Quality mining permit (BBCC 1998).

Groundwater Location and Quantity

The project area is located at the western edge of the Washakie Basin and the eastern flank of the Rock Springs uplift. The shape of the Washakie basin is nearly symmetrical and the strata in the basin dip toward the center at two to 12 degrees. Beneath the project area, geologic strata dip gently eastward into the basin (Geology Section 3.1). Groundwater in the basinward-dipping strata is almost entirely found in confined aquifers, although it also occurs under unconfined conditions locally in some alluvial valleys and where saturated rocks are near the surface (Welder and McGreevy 1966). The major system for unconfined groundwater in this area is the Bitter Creek alluvium (BBCC 1998). Welder and McGreevy (1966) suggest that the direction of groundwater movement in the deeper formations is down-dip toward the center of the structural basin and upward into the overlying formations; therefore, groundwater occurring within the project area is generally flowing eastward at a gradient roughly equal to the stratigraphic dip. Recharge occurs along the outcrop areas of formations and low-lying subcrops where water availability is high. Discharge occurs as evaporation, seeps, pit openings and pumped water from wells (BBCC 1998). Recharge to the water bearing strata of the Washakie Basin is principally from the infiltration of precipitation (direct rainfall, overland flow, and snowmelt). However, most of the precipitation leaves the area as surface runoff before it can infiltrate. The estimated recharge rate for the general area ranges from 0.01 to 2.0 inches per year (Heath 1984). Groundwater discharge from the basin is principally by evaporation and underflow beneath stream channels. Discharge via water wells and transpiration by plants is not considerable (Welder and McGreevy 1966).

Several rock units can be classified as water-bearing zones (aquifers) within the Washakie structural basin of southwest Wyoming. As described in Table 3-5, these aquifers vary in thickness, potential well yields, and water quality. The formations underlined in Table 3-5 are those encountered within the project area (Geology Section 3.1) to a depth of approximately 10,000 feet below land surface. The two geologic units that outcrop within the project area are the Fort Union Formation and the main body of the Wasatch Formation. These two Tertiary-age formations are widely distributed in the Washakie basin and most wells and springs produce and issue from them (Eddy-Miller et al. 1996). The Tertiary aquifer system is the most extensively distributed and accessible source of groundwater in the Washakie and Great Divide basins (Collentine et al. 1981). The Tertiary aquifer system is described as all the water-bearing strata between the Laney Shale Member of the Green River Formation and the Fox Hills Sandstone, inclusive. Sandstones in the Wasatch Formations generally contain groundwater under artesian conditions (Welder 1968). The majority of the groundwater in the Washakie basin is obtained from Tertiary units and the total estimated use in the basin is between 80,000 and 89,000 acre-feet per year (Collentine et al. 1981).

The Mesaverde Formation is also a major aquifer within the Washakie basin, although due to water quality variability, it is considered a groundwater source near outcrop areas only. Likewise, all of the water-bearing units below the Mesaverde are considered important sources of groundwater only in the vicinity of their outcrops due to water quality considerations. The majority of groundwater presently withdrawn from the Washakie basin is from the Tertiary aquifer system, and where drilling depths permit, the Mesaverde aquifer (Collentine et al. 1981). The Mesaverde Formation is situated between the major confining units of the Lewis Shale above and the Baxter Shale below. The Mesaverde aquifer consists of, in ascending order, the

Table 3-5. Hydrostratigraphy of Southwest and South Central Wyoming, Including the Great Divide and Washakie Basins.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Cenozoic	Quaternary		0-70	• Sand and gravel deposits; fine-grained lake deposits produce poor yields • Used extensively in Little Snake River valley and area north of Rawlins uplift • Well yields generally <30 gpm; springs south of Ferris Mountains flow up to 20 gpm • Transmissivity estimates from area east of Rock springs uplift 168 to 560 gpd/ft • Permeabilities from area east of Rock Springs uplift from 21 to 62 gpd/ft^2 • TDS vary from 200 > 60,000 mg/L
	Tertiary	North Park Formation	0-800	• Minor aquifer, supplies excellent quality spring water to Rawlins • Three wells yield 4 to 20 gpm • Transmissivity estimates from 2 pump tests; 150 and 1,000 gpd/ft • TDS generally < 500 mg/L
		Browns Park Formation	0-1,200	• Excellent aquifer with good interstitial permeability; possible saturated zone 870 ft thick • Well yields range from 3 to 30 gpm • Transmissivity estimates from 100 to 10,000 gpd/ft • Numerous springs maintain baseflow of streams south of the Rawlins area; one spring flows 343 gpm • TDS generally < 500 mg/L
		Bishop Conglomerate	0-200+	• Major aquifer in Rock Springs uplift area • Absence of thick, saturated zones limits well yields; one well yields 42 gpm • Good interstitial permeability
		Uinta/Bridger Formations (Washakie Formation)	0-3,200+	• Relatively impermeable unit with only one questionably identified well and no spring data reported • Very low yields are expected
		Green River Formation (including Tipton, Wilkins Peak, and Laney members)	0-1,500	• Laney Member wells yield up to 200 gpm; other members relatively impermeable and would produce low-yield wells • Laney transmissivity range 110 to 300 gpd/ft; permeability averages 10 gpd/ft^2 • TDS generally <3,000 mg/L

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Wasatch Formation	0-4,000+	• Major aquifer; water-bearing sandstone lenses yield 5 to 250 gpm although most yield 30 to 50 gpm; possible yields of 500 gpm from thick, saturated sequences • Wells tapping the lower sands are artesian in some areas • Transmissivity estimates range from 150 to 10,000 gpd/ft • Porosity and permeability are 16 to 38 percent and 0.04 to 18.2 gpd/ft^2, respectively • TDS generally < 1,000 mg/L but some over 3,000 mg/L
Cenozoic	Tertiary	Battle Springs Formation	0-4,700	• Major aquifer in eastern Great Divide Basin • Well yields range from 1 to 157 gpm • Transmissivity estimates from 29 to 3,157 gpd/ft • Porosity at one oil field was 15 to 25 percent • TDS generally < 1,000 mg/L
		Fort Union Formation	0-2,700+	• Major aquifer, especially around border of basins; discontinuous, isolated water-bearing zones • Well yield ranges from 3 to 300 gpm • Transmissivity estimate generally <2,500 gpd/ft • Porosity 15 to 39 percent • Permeability <1 gpd/ft^2; permeability largely fault-related on east side of Rock Springs uplift • TDS generally from 1,000 to 5,000 mg/L
Mesozoic	Upper Cretaceous	**Lance Formation**	0-4,500+	• Minor aquifer, with well yields generally <25 gpm • Transmissivity estimates generally <20 gpd/ft, with some estimates up around 150 to 200 gpd/ft • Oil field porosity 12 to 26 percent • Oil field permeability 0.007 to 8.2 gpd/ft^2 • TDS generally from 1,000 to 5,000 mg/L
		Fox Hills Sandstone	0-400	• Minor aquifer • Well and spring yields not available • Porosity 20 percent • Transmissivity 10 to 20 gpd/ft • Permeability 0.9 gpd/ft^2

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Lewis Shale	0-2,700+	• Constricting layer mostly of impermeable shale but scattered sandstone lenses may be capable of yielding stock water supplies • Porosity ranges from 6 to 24 percent • Permeability ranges from 0.002 to 0.9 gpd/ft^2 • Transmissivity ranges from 0.03 to 50 gpd/ft
		Mesaverde Group (includes Blair, Rock Springs, Ericson and Almond Formations)	0-2,800	• Major aquifer with maximum well yield of 470 gpm from Rock Springs Formation; most yield less than 100 gpm • Transmissivity estimates generally < 3,000 gpd/ft and much lower in the Almond Formation • Porosity ranges from 8 to 26 percent • Ericson Formation is best water source near Rock Springs uplift • TDS range from 500 to over 50,000 mg/L (below 1,000 mg/L only at outcrops)
Mesozoic	Upper Cretaceous	**Baxter Shale (includes Cody and Steele shales and Niobrara Form)**	2,000-5,000+	• Major regional constricting layer throughout area west of Rawlins uplift • Thin sandstone beds may yield small quantities of water, but high TDS concentrations likely
		Frontier Formation	190-900+	• Productive aquifer; yields range from 1 to >100 gpm • Transmissivity estimates 15,000 to 20,000 gpd/ft for water well pump tests; however, generally <100 gpd/ft for drill stem tests, with maximum of 6,500 gpd/ft • TDS range from 500 to 60,000 mg/L (<1,500 mg/L near outcrops)
	Lower Cretaceous	Mowry Shale	150-525	• Regional constricting layer; well and spring data not available
		Thermopolis Shale (includes Muddy Sandstone Member)	20-235	• Leaky confining unit; water produces from Muddy Sandstone Member in northeast Great Divide Basin • Well and spring data not available
		Cloverly Formation	45-240	• Major aquifer which crops out on Rawlins uplift; deeply buried over most of area • Well yields range from 25 to >120 gpm • Transmissivity estimates range from 1 to 1,700 gpd/ft (combined water well and drill stem) • TDS range from 200 to 60,000 mg/L (1,500 mg/L near outcrops)
	Upper Jurassic	Morrison Formation	170-450+	• Confining unit • Well and spring data not available

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Sundance Formation	130-450+	• Artesian flow to several wells in Rawlins area • Well yields between 27 and 35 gpm • Transmissivity ranges from 12 to 3,500 gpd/ft • TDS range from 1,100 to 40,000 mg/L (<1,500 mg/L near outcrops)
	Lower Jurassic-Upper Triassic	Nugget Sandstone	0-650+	• Well yield data limited but range from 35 to 200 gpm • Maximum transmissivity from drill stem tests 2,166 gpd/ft • TDS range from 1,100 to 40,000 mg/L (<1,500 mg/L near outcrops)
	Triassic	Chugwater Formation	900-1,500+	• Confining unit; hydrologic data not available
Mesozoic/ Paleozoic	Lower Triassic-Permian	Phosphoria Formation	170-460	• Water-bearing capabilities poorly known; probably poor due to low permeability of rock units • TDS generally between 5,000 to 10,000 mg/L
Paleozoic	Permian-Pennsylvanian	Tensleep Formation	0-840+	• Important water-bearing zone; well yields range from 24 to 400 gpm • One spring flows 200 gpm in Rawlins area • Transmissivity generally low, range 1 to 374 gpd/ft • TDS generally > 3,000 mg/L
Paleozoic	Lower and Middle Pennsylvanian	Amaden Formation	0-260+	• Hydrologic data not available; unit probably has poor water-bearing potential due to predominance of fine-grained sediments • TDS generally > 10,000 mg/L
	Mississippian	Madison Limestone	5-325+	• Major aquifer; excellent secondary permeability development due to solution channeling, caverns, and fractures • Well yields up to 400 gpm • Transmissivities highly variable • TDS range from 1,000 to >10,000 mg/L
	Cambrian	Undifferentiated	0-800+	• Major water-bearing zone, especially near Rawlins • Well yields between 4 and 250 gpm • Transmissivity data are suspect • TDS generally <1,000 mg/L but some areas with 5,000 to 10,000 mg/L
Precambrian			unknown	• Frequently used aquifer in northwestern corner of Great Divide Basin near South Pass City • Well yields typically range from 10 to 20 gpm • Reported transmissivities are <1,000 gpd/ft • Generally high permeability in fractured and weathered zone in upper 200 ft of unit

Adapted from Collentine et al. (1981); additional sources include Lowham et al. (1985), Heath (1964), and Freethey (1967)

Blair, Rock Springs, Ericson, and Almond formations (Collentine et al.1981). The upper part of the Almond Formation consists of permeable massive beds of fossiliferous sandstone, which overlie low-permeability carbonaceous shale, siltstone, mudstone, and coal beds of variable thickness and quality (Collentine et al. 1981). Dana (1962) reported that one well completed in the upper sandstone yields 250 gpm. Transmissivity values determined from coal mine pumping tests on saturated coal beds of the Almond Formation are relatively low, between 0.7 and 15.8 gpd/ft (Collentine et al. 1981). The Fort Union consists of gray or brown carbonaceous shale, gray shale, gray and green mudstone, gray very fine to medium-grained sandstones and minor thin gray limy siltstones, gray claystone and coal. The sandstone in this unit has been found to contain some zones of high permeability and may yield up to 25 gpm. However, the sand layers are not large in extent and are discontinuous over the region (BBCC 1998).

Beneath the project area the Wasatch Formation varies from zero to about 2,200 feet thick; the Fort Union Formation varies from about 800 feet to 1,800 feet thick; and the Mesaverde Formation is around 4,000 feet thick. The Copper Ridge Shallow Gas Project is proposing varying drilling depths between approximately 2,000 feet and 4,500 feet. Coal seams of the Fort Union Formation and Almond Formation occur at these depths in the project area.

The Black Butte Coal Mine, which is located about 10 to 20 miles north of the project area, is actively mining coal seams of the Fort Union, Lance, and Almond Formations. Black Butte Mine's mining permit describes these coal seams as the most regionally-extensive, water-bearing strata in the general area of the mine. Through drilling programs and monitor well installations at the Black Butte Mine facility, it is observed that the Wasatch is generally dry. Water in quantities sufficient for industrial supply is found in the Ericson. Other formations with water in varying quantities include the Almond, Lance, and Fort Union. Saturated zones of these formations are often discontinuous and occur as perched systems at the Black Butte mine site (BBCC 1998).

Most of the mine's Fort Union and Almond Formation coal seam monitoring wells are 100 to 400 feet deep and typically yield around 5 to 25 gpm. The coal seams are confined between relatively impermeable shales and the average transmissivity value for the Fort Union and Almond Formation coal seams are 100 gpd/ft and 30 gpd/ft respectively. The Fort Union Formation sandstones exhibit high transmissivity values, averaging about 8835 gpd/ft. These sandstones are generally soft, fine grained, and saturated, especially when located close to the Bitter Creek valley (BBCC 1998).

At the Black Butte Coal Mine, the coal seams within the Fort Union and Lance Formations are the only important lithologic units that are extensive in areal extent. The sandstones within these formations, however, are discontinuous and of limited areal extent and are therefore, only important as local potential aquifers (BBCC 1998). A recent (January 2003) SEO records review revealed that there are currently no active groundwater permits in the project area.

3.4.3.2 Groundwater Quality

Groundwater quality is largely related to the depth of the respective source aquifer, flow between aquifers, and the rock type. The quality of water in the various geologic formations underlying the Washakie Basin ranges from poor to good (Welder 1966). The total dissolved solids (TDS) concentration is an indication of salinity. Elevated TDS is caused by a variety of factors, including evapotranspiration, mixing of adjacent aquifers, the presence of soluble material, and restriction of flow by faults or impermeable strata. TDS ranging from less than

1,000 mg/L (considered fresh) to roughly 2,000 mg/L (slightly saline to saline) is typically found within shallow members of the Tertiary aquifer system and near the outcrop areas of the Mesaverde Formation and older aquifers. Shallow groundwater (<1,500 feet) from all members of the Tertiary aquifer system generally have a TDS concentration of less than 3,000 mg/L. Saturated alluvial aquifers that are associated with larger, intermittent streams in the area, such as Bitter Creek and Salt Wells Creek, commonly have high TDS concentrations. The TDS concentration is usually higher when an aquifer is interbedded with lake deposits that contain evaporate minerals (i.e., Washakie Formation).

The TDS concentration of groundwater from the Mesaverde Group varies from less than 500 to over 50,000 mg/L (Collentine 1981). The rate of increase in TDS away from the outcrop is variable, with the most saline Mesaverde waters found along the east flank of the Rock Springs uplift at a relatively short distance from the outcrop. The high TDS levels that exist basinward may result from a fault-related restriction of ground-water circulation, or alternatively, through a fracture-controlled influx of saline waters from stratigraphically adjacent shales and/or overlying alluvium. The existence of stratigraphic gas traps and the generally low permeability (<1 gpd/ft^2) of Mesaverde gas reservoir rocks in this area indicate that zones of highly restricted flow also contribute to the high salinity levels (Collentine 1981). Major ion composition of Mesaverde aquifer water varies with salinity, and therefore with location within the Washakie basin. Water containing 1,000 to 3,000 mg/L TDS is enriched in calcium sulfate, probably from gypsum/ anhydrite dissolution. Increasingly saline water is characterized by dissolved sodium, chloride, and bicarbonate, and is essentially free of sulfate.

A search of the Wyoming Water Resources Data System (WRDS 2003) was conducted for the analyses of groundwater samples collected from any wells located near the project area. The search revealed the chemical analyses of miscellaneous samples collected from eight wells: two completed in the Green River Formation; one completed in the Wasatch/Fort Union Formation; three completed in the Almond Formation; and two completed in the Baxter Shale. None of these wells are located closer than about six miles from the project area. One sample was collected from the Wasatch/Fort Union well and the water type was a calcium sulfate with a TDS concentration of 2,400 mg/L. Seventeen samples were collected from one of the Almond wells and the water type was a sodium bicarbonate with an average TDS concentration of 2,040 mg/L. Eleven samples were collected from the second Almond well and the water type was a calcium sulfate with an average TDS concentration of 3,740 mg/L. One sample was collected from the third Almond well and the water type was a sodium sulfate with a TDS concentration of 711 mg/L.

Because the Copper Ridge Shallow Gas Project is proposing drilling to depths between approximately 2,000 feet and 4,500 feet, and coal seams of the Fort Union and Almond Formations occur at these depths, the chemical characteristics of groundwater from Fort Union and Almond coal seams as identified by the Black Butte Coal Mine are included. The predominant ionic constituents of groundwaters within these coal seams are sodium and bicarbonate. Wells at the Black Butte Mine facility show that both the Fort Union and Almond formations are sodium bicarbonate/sulfate types. Wells completed in the Fort Union formation demonstrate sodium concentrations ranging from 441 to 1267 mg/L, with a mean of 860 mg/L. The SAR values range from 16.5 to 39, with a mean of 36 and have a TDS range from 1230 to 3497 mg/L. A well completed in the Almond formation is of the sodium bicarbonate sulfate type. Sodium, bicarbonate and sulfate concentrations are 723 mg/L, 892 mg/L, and 263 mg/L, respectively. A low recharge and slow movement of water in these aquifers often are the major causes of a high degree of mineralization (BBCC 1998).

The confining beds restrict the movement of groundwater between aquifers, hence, movement of potential contaminants between aquifers. Although there is some downward movement of the water from the shallow surficial units, most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. Concerns have been raised for several gas field projects in southwest Wyoming regarding groundwater quality degradation due to the piercing of confining layers and vertical and horizontal migration and mixing of water of variable qualities. Data suggesting this is a current problem in the project area are not available. Improperly completed injection wells could also be a potential source of contamination between aquifers.

3.5 VEGETATION, WETLANDS AND NOXIOUS WEEDS

3.5.1 General Vegetation

Vegetation on the CRPA is primarily dominated by Wyoming big sagebrush/mixed grass prairie and desert shrub communities. The project area is located within the Green River and Great Divide Basin (7" - 9") precipitation zone, Region 4 (USDA-SCS 1986). Accordingly, native plants in this area of southwest Wyoming are primarily drought-tolerant low shrub, grass, and flowering forb species.

3.5.1.1 Vegetation Cover Types

A vegetation cover-type map of the CRPA (Figure 3-6) was provided by the Wyoming Geographic Information Science Center (WYGISC 2003) and used to delineate primary and secondary land cover type boundaries. Information for secondary vegetation types and plant species of concern was provided by the Wyoming Natural Diversity Database (WYNDD 2003).

Based upon the Wyoming Gap Analysis Program (GAP, Merrill et al. 1996), Wyoming big sagebrush (97.4 percent) and desert shrubs (2.6 percent) are the primary cover types on the project area (Table 3-6). Secondary cover types are desert shrub populations in the northwestern quadrant of the area (25.1 percent), Wyoming big sagebrush in the southwestern quadrant (2.6 percent), with the remainder of the area classified as a mixed grass prairie type (72.3 percent).

Wyoming big sagebrush: Wyoming big sagebrush (*Artemesia tridentada* ssp*.wyomingensis*) is the most extensive cover type in the project area, covering 24,304.2 acres (97.4%). The description of this cover type from the Wyoming GAP analysis is as follows (Merrill et al. 1996),"Total shrub cover in this type comprises more than 25% of the total vegetative cover. This type is variable in Wyoming and ranges from dense, homogeneous Wyoming big sagebrush to sparsely vegetated arid areas where Wyoming big sagebrush is the dominant shrub. Often, patches of Wyoming big sagebrush are found with patches of mixed grasses. In these cases the type is classified as Wyoming big sagebrush steppe if the sagebrush patches occupy more than 50% of the total landscape area and as mixed grass if the grasses occupy more than 50% of the total area." Resolution of the GAP layer is approximately 100 hectares (248 acres), therefore, smaller stands of some secondary cover-types such as basin big

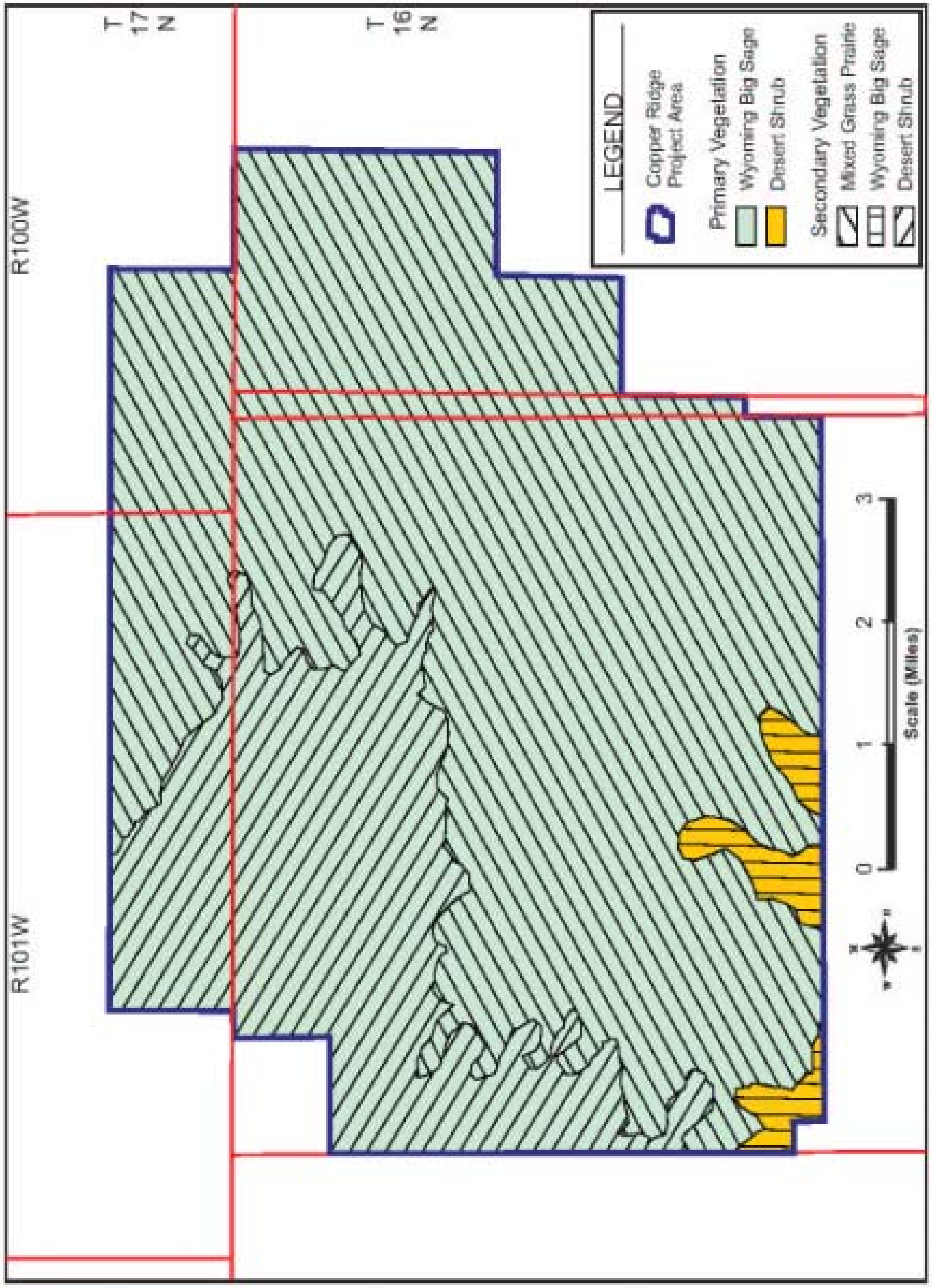


Figure 3-6. Vegetation Cover Types on the Copper Ridge Project Area.

sagebrush (*Artemisia tridentata* ssp. *tridentata*) and cushion plant communities, although present, may fail to appear on the map and their extent cannot be calculated.

Table 3-6. Vegetation Cover Types within the Copper Ridge Project Area.

	Primary		Secondary	
Vegetation Cover Type	Acres	Percent	Acres	Percent
Wyoming big sage	24304.2	97.4	648.8	2.6
Desert shrub	648.8	2.6	6263.2	25.1
Mixed grass prairie	0.0	0.0	18041.0	72.3
TOTAL	24953.0	100.0	24953.0	100.0

Mixed grass prairie: This is a "catch-all" type for grasslands that contain a mixture of short grass and tall grass prairie species. These grasslands do not contain buffalo grass, considered an indicator of short grass prairie. Mixed grass prairie often occurs in patches intermixed with shrub species such as sagebrush. Dominant plant species in this cover type include: thickspike wheatgrass (*Agropyron dasystachyum*), western wheat grass (*Agropyron smithii*), bottlebush squirreltail (*Sitanion hystrix*), needle-and-thread (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass *(Agropyron spicatum*), and threadleaf sedge (*Carex filifolia*). Forbs and especially woody crowned half-shrubs such as Hood's phlox (*Phlox hoodii*), Hooker's sandwort (*Arenaria hookeri*), cushion wild buckwheat (*Eriogonum ovalifolium*), green rabbitbrush (*Chrysothamnus viscidiflorus*), winterfat (*Eurotia lanata*), and broom snakeweed (*Gutierrezia sarothrae*) occur in some locations as understory dominants with the sagebrush. These sites are usually alkaline with limited permeability, and often occur on thin soils with rocky or gravelly subsurface materials. Locoweed (*Oxytropis* ssp.) and milkvetch (*Astragulus* spp.) are poisonous plants often occurring with this cover type (Merrill et al. 1996).

Desert shrub: This type is a "catch-all" for a mixture of shrubs usually associated with dry, saline habitats. Shrub cover is often dominated by alkaline/saline adapted species such as shadscale saltbush (*Atriplex confertifolia*), but can be a mixture of Gardner's saltbush (*Atriplex gardneri*), greasewood (*Sarcobatus vermiculatus*) and/or desert cushion plants (Merrill et al. 1996).

3.5.1.2 Biological Soil Crusts

An often overlooked, but extremely vital component of Wyoming's semiarid rangelands, especially in the Wyoming big sagebrush cover type, are the biological soil crusts that occupy most of the open space not occupied by vascular plants. Biological soil crusts predominantly are composed of cyanobacteria (formerly blue-green algae), green and brown algae, mosses, and lichens. Liverworts, fungi, and bacteria can also be important components. Because they are concentrated in the top 1-4 mm of soil, they primarily affect processes that occur at the soil surface or soil-air interface, including soil stability, decreased erosion potential, atmospheric N-fixation, nutrient contributions to plants, soil-plant-water relations, infiltration, seeding germination, and plant growth (Belnap et al. 2001). Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances such as trampling by humans and livestock, wild horses, wildlife, or vehicles driving off roads. Disruption of the crusts decreases organism diversity, soil nutrients, stability, and organic matter (USGS 2002).

3.5.2 Noxious Weeds

On 3 February 1999, Executive Order (EO) 13112 ("Invasive Species") was signed by President Clinton. The primary purpose of this EO is to prevent the introduction of invasive species and provides for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. In Wyoming, some 428 taxa have been documented as invasive (Hartman and Nelson 2000). Of these 428 taxa, 22 are designated as noxious by the State of Wyoming (Rice 2002) and are shown in Table 3-7.

Noxious weeds are very aggressive and invading infestations tend to exclude other native plant species thereby reducing the overall forage production of desirable shrubs, herbaceous grasses and forbs. The project area is vulnerable to infestations of noxious weeds, especially on newly disturbed surfaces. Current drought conditions in Wyoming (NOAA 2003) increase the probability that noxious weeds will become established in stressed or disturbed habitats.

Table 3-7. Designated Noxious Weeds in Wyoming.[1]

Scientific Name	Common Name
Agropyron repens	Quackgrass
Ambrosia tomentosa	Skeletonleaf bursage
Arctium minus	Common burdock
Cardaria draba, C. pubescens	Hoary cress, whitetop
Carduus acanthoides	Plumeless thistle
Carduus nutans	Musk thistle
Centaurea diffusa	Diffuse knapweed
Centaurea maculosa	Spotted knapweed
Centaurea repens	Russian knapweed
Chrysanthemum leucanthemum	Ox-eye daisy
Cirsium arvense	Canada thistle
Convolvulus arvensis	Field bindweed
Cynoglossum officinale	Houndstongue
Euphorbia esula	Leafy spurge
Isatis tinctoria	Dyers woad
Lepidium latifolium	Perennial pepperweed
Linaria dalmatica	Dalmatian toadflax
Linaria vulgaris	Yellow toadflax
Lythrum salicaria	Purple loosestrife
Onopordum acanthium	Scotch thistle
Sonchus arvensis	Perennial sowthistle
Tamarisk spp.	Salt cedar

[1]Designated Noxious Weeds, Wyoming Stat. § 11-5-102 (a)(xi) and Prohibited Noxious Weeds, Wyoming Stat. § 11-12-104.

3.5.3 Waters of the United States, Including Wetlands

<u>Waters of the US</u> - Most of the surface water features in the project area qualify as Waters of the United States. Waters of the U.S. include territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams); special aquatic sites and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and COE. Many of the drainage channels identified on the USGS topographic maps are vegetated swales, which are not considered to be waters of the U.S. by the COE. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the state engineer's office (SEO) of Wyoming.

Wetlands - Wetlands are a unique and important cover type due to their ecological value and protection under the federal Clean Water Act (CWA) of 1972, as amended. Jurisdictional wetlands and other aquatic habitats merit special concern due to their relative rarity in the arid West, their functional role in and as components of hydrologic systems, their unique and important wildlife habitat and forage value, their heritage value, and their protection and regulation under the CWA.

The Green River RMP (USDI-BLM 1997) defines wetlands as lands transitional between terrestrial and aquatic systems where the water is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominately hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. The most common wetland classification system used in Wyoming is the Cowardin System (Cowardin et al. 1979). Under this system, all wetlands in Wyoming belong to one of three different inland systems: (1) Palustrine (marsh or pond-like), (2) Lacustrine (lake-like), or (3) Riverine (river-like).

The location and classification of potential wetlands in the CRPA were determined from a draft USFWS National Wetlands Inventory (NWI) map (Figure 3-7) provided by the WYGISC (2003). Several polygon wetlands are located near the Brady Plant in Section 11, T16N:R101W. The Cowardin System classifies these locations as follows: PEMC (Palustrine, emergent, seasonally flooded), PUBFx (Palustrine, unconsolidated bottom, semi-permanently flooded, excavated), PUSAh (Palustrine, unconsolidated shore, temporarily flooded, diked/impounded), and PUSCh (Palustrine, unconsolidated shore, seasonally flooded, diked/impounded). In Wyoming, PEMC classified wetlands are usually associated with irrigated meadows and hay fields. The linear wetland feature shown in Section 8, T16N:R100W is classified as Riverine (intermittent streambed). All drainages (streams, draws, washes) in the CRPA are within the WDEQ fifth order hydrologic unit WYGR14040105 and eventually drain into the Green River (WDEQ 2001).

3.6 RANGE RESOURCES

The CRPA is located within the Rock Springs grazing allotment (No. 13018) which encompasses a total of about 2,127,200 acres. Land surface area of the CRPA (24,953 acres) represents about 1.3% of the total land area of the Rock Springs allotment. A total of 180,234 AUM's (public 105,584; other federal 5,015; State 1,182; and private 68,453) are authorized by the BLM for the allotment, however, this amount may be reduced in drought years, to protect the

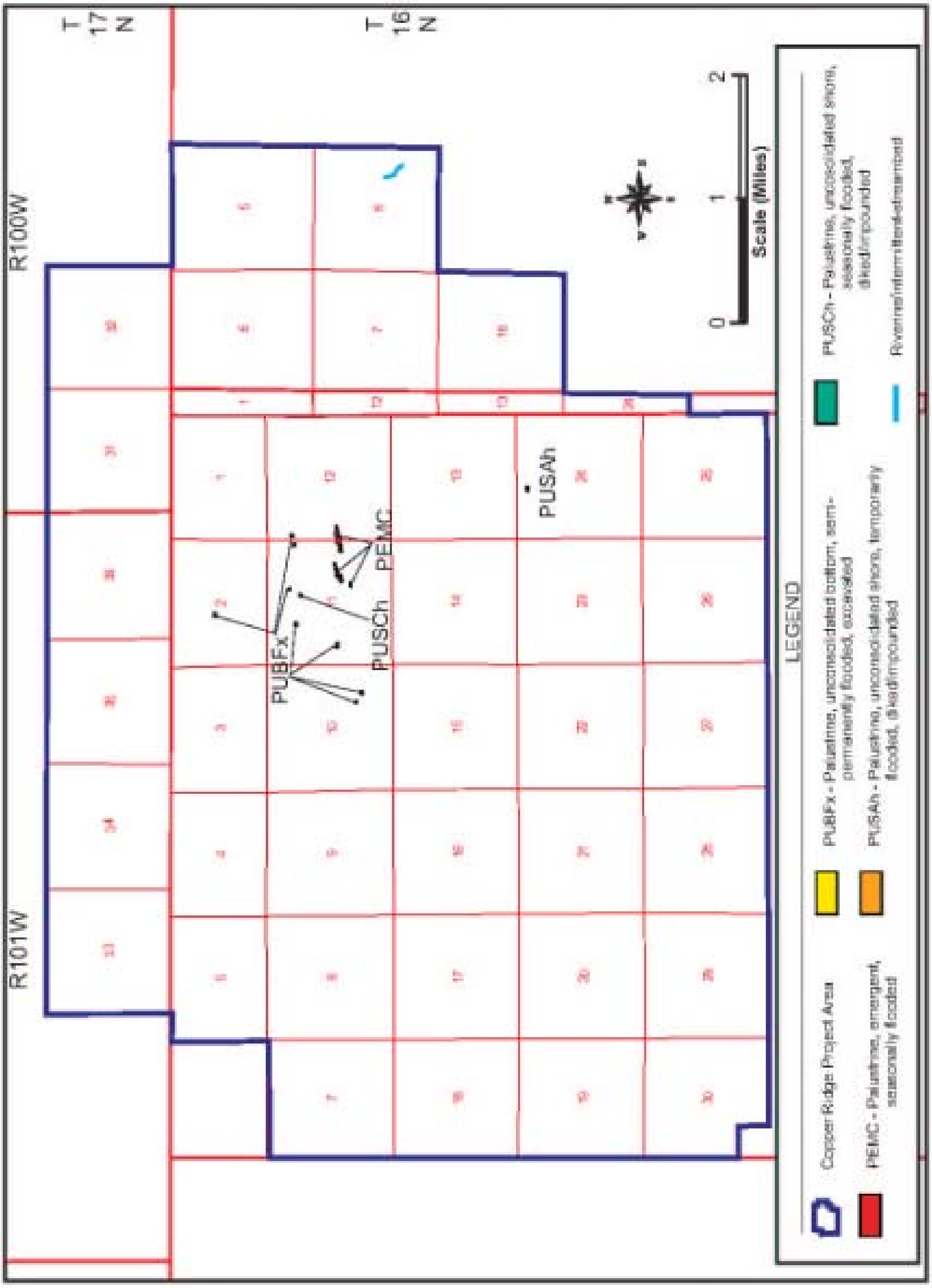


Figure 3-7. Wetland Cover Types on the CRPA

rangeland resource (Lloyd, pers. comm. 2003). An AUM is defined as the amount of forage required to sustain one mature cow or the equivalent based on an average daily forage consumption of 26 pounds of dry matter per day for one month (780 pounds per month). The grazing ratio on the Rock Springs allotment is about 14.0 acres per AUM. The RSGA predominantly supervises cattle and sheep grazing on the CRPA.

3.7 WILDLIFE

3.7.1 Introduction

The CRPA lies within the BLM's Green River Resource Area administered by the Rock Springs Field Office. Objectives for wildlife management on the resource area are directed by the Green River RMP (USDI-BLM 1997). The RMP provides for multiple use planning and management of public lands and resources in a combination designed to meet present and future needs.

The project area is small (24,953 acres) relative to the overall size of the RSFO resource area (5.36 million acres), yet this area provides diverse habitat that supports a wide variety of resident, migrant, and seasonally resident wildlife species. Because many wildlife species are highly mobile and can readily move in and out of the project area, records of current and historical wildlife species occurrences were obtained for the project area and a six-mile zone surrounding it. Since activities within the permit area could potentially affect nesting raptors and greater sage-grouse breeding activities that are outside the project area, the area of analysis was expanded for these species to include a 1-mile and 2-mile buffer zone, respectively.

Information concerning current and historical wildlife locations was obtained from several sources. Information regarding greater sage-grouse lek and raptor nest locations was obtained from the BLM Rock Springs Field Office. Additional information was acquired from the Wyoming Game and Fish Department (WGFD) Wildlife Observation System (WOS). This listing contains records for all types of wildlife (birds, mammals, reptiles, amphibians). The Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming (WGFD 1999) was also used to assess the potential occurrence of species in the project area. This atlas divides Wyoming into 28 degree blocks, and the presence or absence and breeding activity of vertebrate species are documented by degree block. The project area is located in degree block 24. A species was considered to have the potential for occurrence in the project area if it was reported as observed, breeding, or historically present within degree block 24. Annual big game herd unit reports from the WGFD were also used. Finally, data was acquired from Wyoming Natural Diversity Database (WYNDD). Location records for vertebrate species of special concern (federal or state) within a township buffer of the project area were obtained from WYNDD (2002). Although wild horses are not managed as a wildlife species by the WGFD and BLM, they are included in the wildlife sections of this document.

3.7.2 Wildlife Habitat

Wildlife habitats that could be affected by the project include both the areas which would be physically disturbed by the construction of gas wells, related roads, pipelines, and production facilities, as well as zones of influence surrounding them. Zones of influence are defined as those areas surrounding, or associated with, project activities where impacts to a given species or its habitat could occur. The shape and extent of such zones varies with species and circumstance.

Two primary wildlife habitats are found in the project area. These habitat types correspond with vegetation cover types described in Section 3.5 of this document. Upland habitats include: (1) Wyoming big sagebrush steppe, and (2) desert shrub. Wetland habitats include non-permanent marsh and intermittent streambed habitats.

3.7.3 General Wildlife

A total of 309 species has been recorded on or proximal to the project area either as residents or migrants and includes 57 mammal species, 242 bird species, 4 amphibian species, and 6 reptile species (Appendix B). The presence of these wildlife species was determined solely from the sources of information discussed in Section 3.7.1. Wildlife surveys for raptors, greater sage-grouse, mountain plovers, and white-tailed prairie dogs were conducted on the CRPA by HWA during the spring of 2003 and results of these surveys are given in the appropriate sections of this document.

Although all species in Appendix B are important members of a functioning ecosystem and wildlife community, most are common and have wide distributions in the region. Consequently, the relationship of most of these species to the proposed project are not discussed in the same depth as species which are threatened, endangered, rare, of special concern, of special economic interest, or are otherwise of high interest or unique value.

3.7.4 Big Game

Three big game species: mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), and pronghorn antelope (*Antilocapra americana*) occur on the project area. Big game populations are managed by the WGFD within areas designated as herd units and are discussed in that context.

The types of big game habitat designated by WGFD (1996, 2002a), and discussed in this document, include yearlong, winter/yearlong, crucial winter/yearlong, and undetermined. Winter/yearlong ranges are occupied throughout the year but during winter, they are used by additional animals that migrate from other seasonal ranges. Yearlong ranges are occupied throughout the year and do not receive an influx of animals during winter. Crucial range (i.e. crucial winter/yearlong) describes any seasonal range or habitat component that has been documented as a determining factor in a population's ability to maintain itself at a specified level (theoretically at or above the population objective) over the long term. Crucial ranges are typically used 8 out of 10 winters. Areas designated as UND (or undetermined) contain habitats of undetermined importance to the species.

Mule Deer. The project area lies within the South Rock Springs Herd Unit. This unit covers 1,477,156 acres of habitat in southwest Wyoming (WGFD 1996). This migratory herd is shared with Colorado and Utah making it difficult to estimate the Wyoming population during and after the hunting season. The 2001 posthunt population estimate for the herd unit was 7,000, approximately 40% below the herd objective of 11,750 animals (WGFD 2002a). The project area is located within hunt area 101; 2001 hunter success in this area was 73% with a harvest of 90 mule deer bucks. Approximately 28% of the mule deer harvest in the South Rock Springs Herd Unit was from hunt area 101 in 2001.

Two types of mule deer seasonal ranges are located within the project area (Figure 3-8). The entire project area is classified as some type of mule deer winter range: either winter/yearlong or crucial winter/yearlong (Table 3-9). Nearly 5% (1,108 acres) of the project area is crucial winter/yearlong mule deer range, located in the southeastern portion of the project area. The remaining 23,845 acres (95%) of the project area is mule deer winter/yearlong range.

Elk. The project area lies within the 1,836,488-acre Petition Herd Unit. The herd unit consists of isolated groups of elk that utilize the higher elevation ridges and adjacent habitats within a desert area. It is difficult to determine a population estimate for this herd because there are few animals scattered over a large area and a portion of the herd is migratory and interchanges with elk herds in Colorado. The estimated population for this herd unit is 250 - 300 animals (WGFD 2002a). The project area is located in hunt area 124, and in 2001 hunter success in this area was 53.8% with a harvest of 5 bulls and 30 antlerless elk.

There are approximately 55 acres (0.2%) of elk yearlong range in the project area (Table 3-9). This yearlong range is located in the southern and eastern portion of the project area (Figure 3-9). The remainder of the project area (over 99%) is of undetermined value and has not been classified as any type of elk seasonal range.

Pronghorn. The project area lies within the Bitter Creek Herd Unit. This unit contains hunt areas 57 and 58 and covers 1,835,828 acres of sagebrush-grasslands, greasewood and saltbush flats, juniper woodlands, barren badlands, and irrigated agricultural field habitats (WGFD 2002a). The population objective for this herd unit is 25,000 and the 2001 posthunt population estimate was 13,000. The CRPA is located in hunt area 58, and in 2001 hunter success was 76% with a harvest of 145 males, 3 females, and 2 juveniles (WGFD 2002a).

Approximately 10% or 2,433 acres of the project area is classified as crucial winter/yearlong habitat (Table 3-9). Crucial winter/yearlong pronghorn range is found only in the northern portion of the project area (Figure 3-10). The remaining portion (90%) of the project area is used during winter and year-round (winter/yearlong) by pronghorn.

Big Game Summary. Overall, the entire project area is used year-round by two big game species (antelope and mule deer). The northern portion of the project area provides crucial habitat for antelope, while the southeastern portion of the project area provides crucial habitat for mule deer. Although the value of elk habitat throughout most of the project area has not yet been determined, portions of the project area are classified as elk yearlong range indicating habitat found in that area is important.

Table 3-8. Big game seasonal ranges within the Copper Ridge Project Area.

Seasonal Range[1] Areas (acres)				
Species	WYL	YRL	CWYL	UND
Mule Deer	23,845	-	1108	-
Elk	-	55	-	24,898
Pronghorn	22,520	-	2,433	-

[1] - WYL: Winter/Yearlong, YRL: Yearlong, CWYL: Crucial Winter/Yearlong, UND: Undetermined

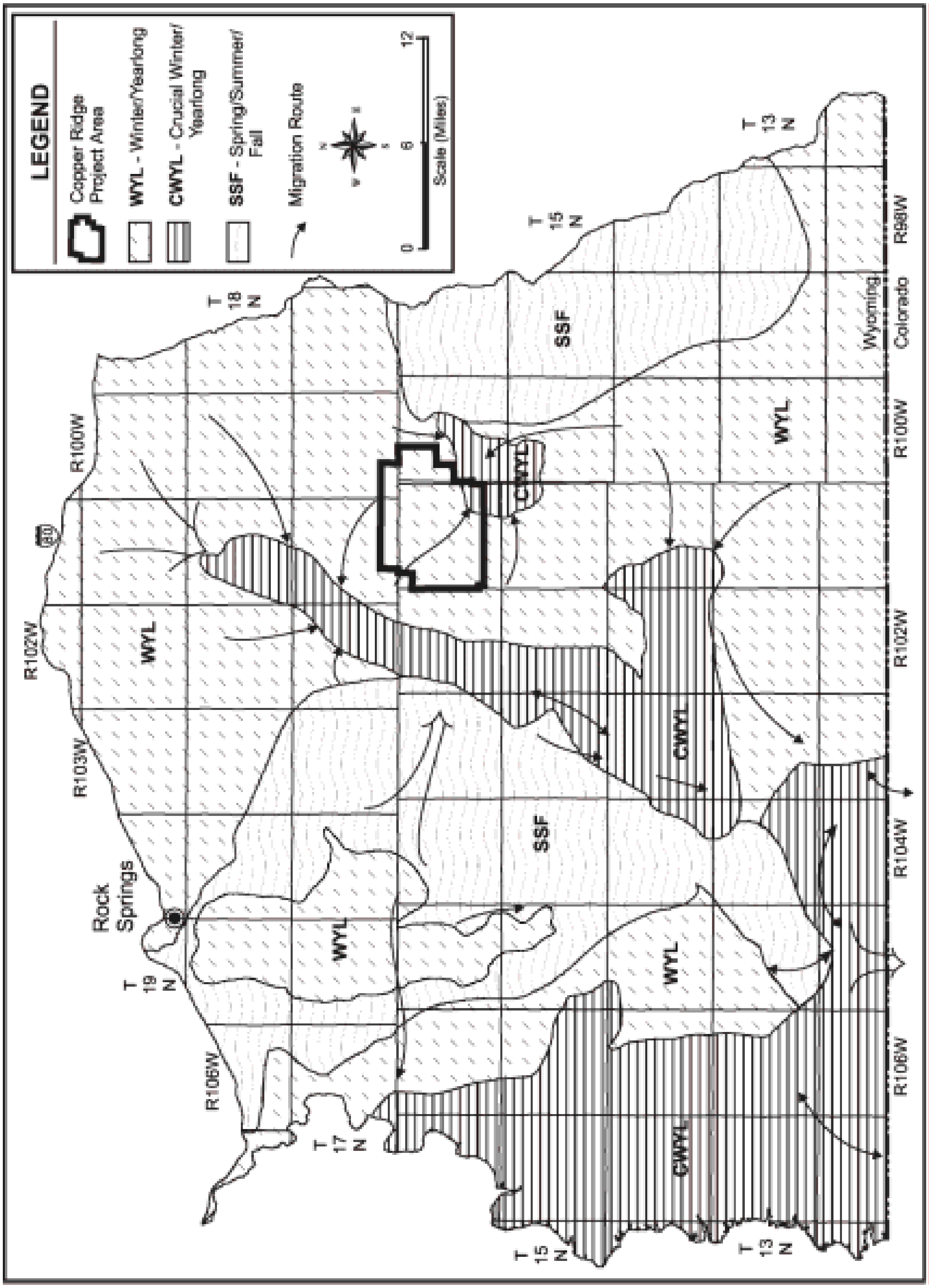


Figure 3-8. South Rock Springs Mule Deer Herd Unit Seasonal Ranges in Relation to the CRPA.

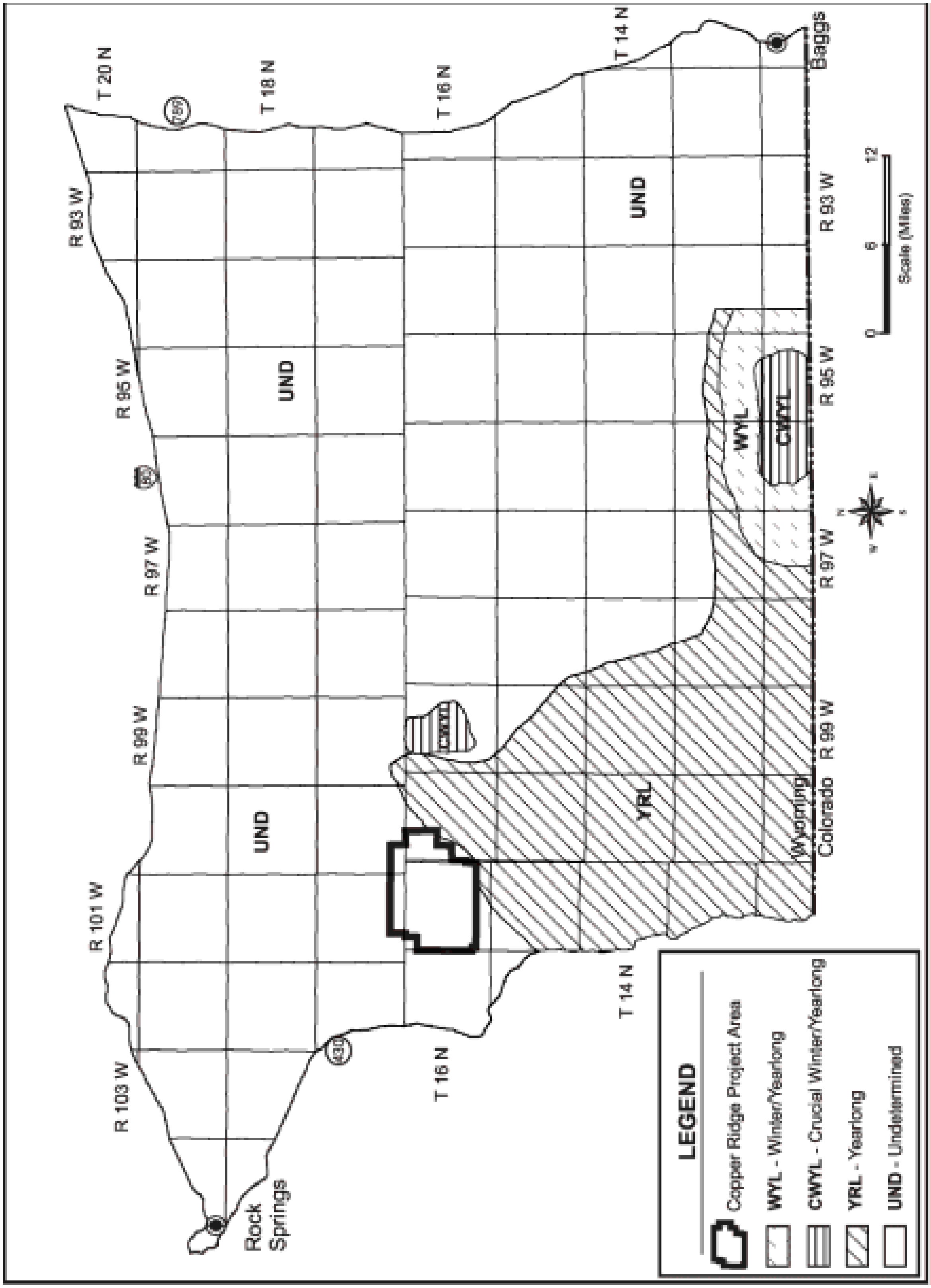


Figure 3-9. Petition Elk Herd Unit Seasonal Ranges in Relation to the CRPA.

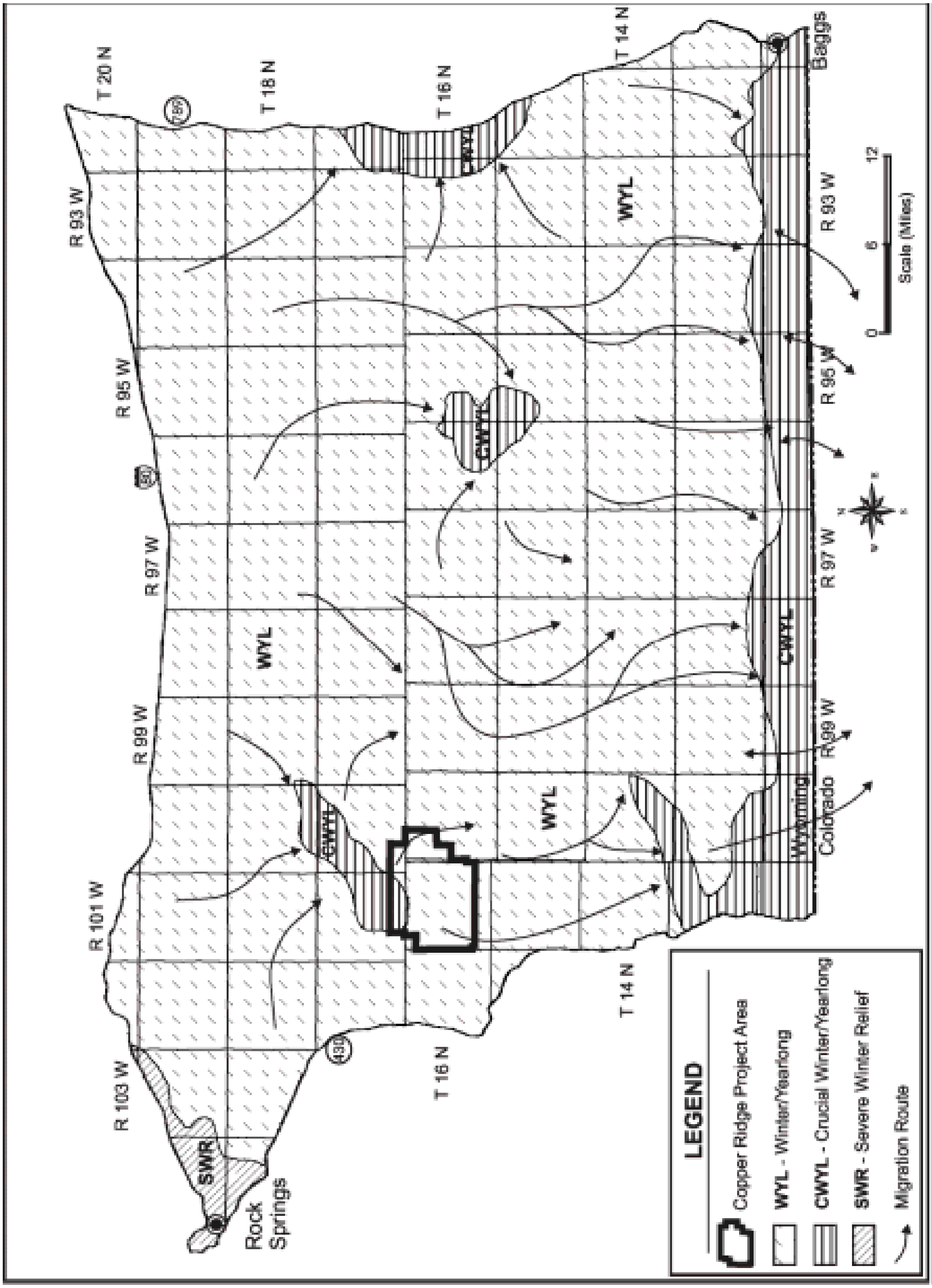


Figure 3.10. Bitter Creek Pronghorn Herd Unit in Relation to the CRPA.

3.7.5 Wild Horses

The CRPA lies within the Salt Wells and Adobe Town Wild Horse Herd Management Areas (HMA), which encompasses about 1,573,585 acres. Boundaries of the HMAs extend from Highway 191 south of Rock Springs east into to the Rawlins Field Office area boundary and south to the Wyoming-Colorado state line (USDI-BLM 1999). The total surface area of the CRPA represents about 1.5% of the total land surface area of the two HMAs.

The BLM establishes an appropriate management level (AML) for each HMA. The AML is the population objective for the HMA that will ensure a thriving ecological balance among all the users and resources of the HMA. The AML for the Salt Wells HMA ranges from 251 to 365 (USDI-BLM 1999). The current (11.17.03) wild horse population estimate for the Salt Wells HMA is 345 animals due to recent gathering operations. The Adobe town HMA is managed by the Rawlins Field Office. Both HMAs share a common, unfenced boundary.

With no known natural predators, the historical annual rate of increase in wild horse populations in the RSFO area is about 20 percent (USDI-BLM 1999). The human-made hazards to wild horses in the CRPA of importance would be roads and fences. High traffic levels increase the potential for human-caused injuries. Minimal fencing exists in the HMA; these are mostly associated with deeded property or associated with major highways (i.e., Interstate 80, Highways 191 and 430). Most grazing allotments as well as checkerboard lands are unfenced in the Salt Creek HMA (USDI-BLM 1999).

3.7.6 Upland Game Birds

The greater sage-grouse and mourning dove are the only upland game bird species known to occur on or around the project area, which lies within the Flaming Gorge Upland Game Management Area (UGMA # 6).

Greater Sage-Grouse. The greater sage-grouse is the upland game bird of primary interest in the project area. The greater sage-grouse is identified by the RSFO of the BLM as a sensitive species, and it has declined over much of its range in the western states during recent years and may be petitioned for listing under the ESA by the USFWS. Populations in Wyoming have recently been in a decline due to a wide range of possible factors including drought, habitat loss, and habitat degradation.

The project area is located within the extensive sagebrush steppe habitat of southern Wyoming where greater sage-grouse are common. Important habitats are strutting grounds (leks), nesting areas, brood-rearing areas, and wintering areas. All of these sage-grouse habitats may occur in a contiguous or patchy and disconnected pattern. Leks may be located between summer and winter ranges, but in some cases, summer and winter ranges may be the same (Call and Maser 1985). According to Call (1974), Braun et al. (1977), and Hayden-Wing et al. (1986), preferred nesting habitat is usually located within two miles of leks.

The estimated greater sage-grouse harvest in UGMA # 6 in 2001 was 812 sage grouse, roughly 6.4% of the statewide harvest (WGFD 2002b).

Sage grouse lek locations on and within two miles of the border of the project area, were obtained through the BLM Rock Springs Field Office: two documented leks within the project area boundary and two documented leks within a 2-mile buffer of the project area boundary

(Figure 3-9). Field surveys were conducted during April, 2003 to determine which leks were being used by sage grouse. At the time of the surveys, the four previously documented leks were active, with 6-20 males displaying at each lek. In addition, three strutting males were observed approximately ¼ mile south of the lek located in Section 8, T16N:R101W.

Mourning Dove. Mourning doves are found west of the project area during the spring and summer months (WGFD 2002c) and are associated with sagebrush-grass, mountain shrub, and riparian habitats. It is likely that some mourning doves utilize the CRPA during the breeding season. Brood production is tied closely to spring and summer precipitation. Availability of sufficient seeds and water likely increases mourning dove productivity. The estimated mourning dove harvest for UGMA # 6 in 2001 was 537 (WGFD 2002b) out of 29,075 for the entire state.

3.7.7 Waterfowl and Shorebirds

Primary use of the project area by waterfowl and shorebirds is minimal because of the small amount of open water and wetlands available (see Section 3.5.2). However, the limited wetlands available may still provide adequate cover and nesting habitat for a limited number of waterfowl.

3.7.8 Raptors

According to the WOS data (WGFD 2002c), two raptor species have been observed on or within six miles of the CRPA: ferruginous hawk (*Buteo regalis*) and bald eagle (*Haliaeetus leucocephalus*). Data from the BLM Rock Springs Field Office show records, from 1986, of eight raptor nests on or within two miles of the project area: seven golden eagle nests and one ferruginous hawk nest.

An aerial survey of the CRPA and surrounding 1-mile buffer was conducted by HWA on June 6, 2003 to locate and determine the activity status of raptor nests. The CRPA and 1-mile buffer area was overflown in a 180 Cessna aircraft; transects were flown approximately ½ mile apart and at 100-200 feet above the ground. All nest locations obtained from the BLM were checked and any new nests were documented and their location recorded. A ground survey was conducted on June 13, 2003 to verify findings of the aerial survey. No active raptor nests were found on the CRPA or 1-mile buffer area. Six inactive Golden Eagle nests and 7 inactive Ferruginous Hawk nests were found (Figure 3-11).

3.8 SPECIAL STATUS WILDLIFE, FISH, AND PLANT SPECIES

Special status species include: (1) threatened, endangered, candidates, or those petitioned for listing as threatened or endangered by the FWS under the Endangered Species Act (ESA) of 1973, as amended; and (2) those designated by the BLM State Director as sensitive (USDI-BLM 2002).

3.8.1 Threatened, Endangered or Proposed for Listing Species of Wildlife, Fish, and Plants

The FWS has determined that one mammal, three bird, four fish, and one plant species listed as either threatened, endangered, candidate or proposed under the ESA may potentially be found

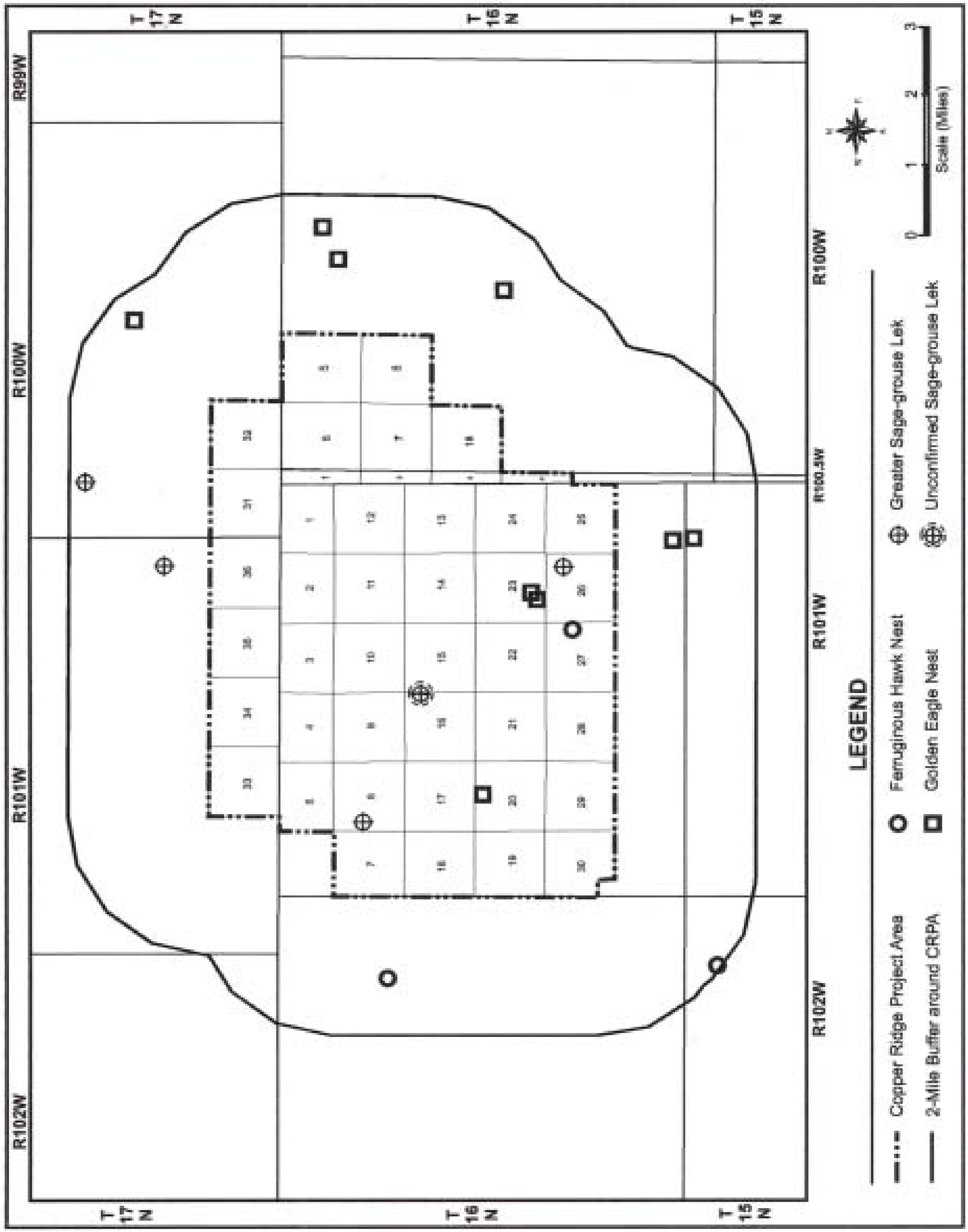


Figure 3-11. Raptor Nest and greater sage-grouse Lek Locations in Relation to the CRPA.

in the project area or be affected by activities conducted on the project area (USDI-FWS 2002a). These species and their federal status under the ESA are listed in Table 3-9. The black-footed ferret, bonytail, Colorado pikeminnow, humpback chub, and razorback sucker are listed as endangered. The yellow-billed cuckoo is a candidate for listing as endangered under the ESA and the bald eagle and Ute ladies'-tresses are classified as threatened. Four endangered fish species, which are downstream residents of the Colorado River System, are included in this analysis because of potential impacts to their habitat. The mountain plover was a species proposed for listing as threatened when public scoping occurred but the FWS has since determined the species does not warrant listing. BLM treats this species as a sensitive species (see Section 3.8.2.2).

Table 3-9. Threatened, endangered, proposed, and candidate species potentially affected by or present on the CRPA.

Species	Scientific Name	Status
Mammals		
Black-footed ferret	*Mustela nigripes*	Endangered
Birds		
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate
Fish		
Bonytail	*Gila elegans*	Endangered
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered
Humpback chub	*Gila cypha*	Endangered
Razorback sucker	*Xyrauchen texanus*	Endangered
Plants		
Ute ladies'-tresses	*Spiranthes diluvialis*	Threatened
Source: USDI-FWS 2002		

3.8.1.1 Mammals

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies. The black-footed ferret's original distribution in North America closely corresponded to that of prairie dogs (Hall and Kelson 1959, Fagerstone 1987). In Wyoming, white-tailed prairie dog (*Cynomys leucurus*) colonies provide essential habitat for black-footed ferrets. Black-footed ferrets depend almost exclusively on prairie dogs for food and they also use prairie dog burrows for shelter, parturition, and raising their young (Hillman and Clark 1980, Fagerstone 1987). Based upon communications with the RSFO and a query of species locations from the WYNDD (2002) and the WOS (WGFD 2002c), it is known that several small white-tailed prairie dog colonies do exist on the project area. Existing white-tailed prairie dog colonies located on the CRPA were mapped by HWA on April 29 and May 1, 2003. Boundaries of the colonies were mapped from the ground using a hand-held GPS receiver. Four small colonies are located in the northern portion of the CRPA; these colonies cover a total of 279.8 acres, with 180.5 acres occurring within the CRPA boundary (Figure 3-12). One of the four colonies, which covered 43.7 acres, was not active during the spring of 2003. Therefore, a total of 136.8 acres of active white-tailed prairie dog colonies occurs on the CRPA. The BLM has made a “no effect” determination for presence of black-footed ferrets for which the FWS has concurred (August 29, 2003). Black-footed ferrets will not be given further consideration in this analysis.

3.8.1.2 Birds

Bald Eagle. Bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers, or lakes. Selection of nests likely depends upon availability of food in the early nesting season (Swenson et al. 1986). The habitat on the project area lacks large perennial water bodies and nesting trees for bald eagles, therefore nesting on the project area is not likely. Wintering areas are typically associated with concentrations of food sources including major rivers that remain unfrozen where fish and waterfowl are available and ungulate winter ranges where carrion is available. One record of bald eagle occurrence within six miles of the project area was recorded in the WOS in August 1987 (WGFD 2002c). Although nesting and wintering habitat is limited, bald eagles may occasionally utilize the project area for hunting habitat. The BLM has made a “no effect” determination for the bald eagle and this species will not be considered further in this analysis.

Yellow-billed Cuckoo. The yellow-billed cuckoo is a neotropical migrant that winters primarily in South America and migrates north into the United States during April and May. The yellow-billed cuckoo feeds primarily on large insects: caterpillars, katydids, cicadas, grasshoppers, and crickets. Occasionally small frogs, lizards, eggs, and young birds are eaten (Hughes 1999). It is a riparian obligate species that requires at least 25 acres of mature riparian woodland, especially cottonwood (*Populus* spp.) or willow (*Salix* spp.) with low, dense undergrowth at elevations below 7,000 feet. The cuckoo prefers 100 acres or more of deciduous woodland at least 100 meters wide. Marginal habitat is at least 10 acres of riparian habitat more than 50 meters in width. Nests are located less than 8 meters above the ground in at least 2.5 acres of dense deciduous vegetation near water (Cerovski et al. 2001).

Due to the lack of adequate habitat on the project area and the fact that no records are documented within six miles of the project area (WGFD 2002c, WYNDD 2002) it is unlikely that the yellow-billed cuckoo occurs on the project area. Thus, this species will not be considered further in this analysis.

3.8.1.3 Fish Species

The Copper Ridge Project Area is located in the Green River drainage of southwest Wyoming. The project area is drained by intermittent/ephemeral streams fed primarily by runoff of winter snows. Four federally endangered fish species may occur as downstream residents of the Colorado River system: bonytail, Colorado pikeminnow, humpback chub, and razorback sucker (USDI-FWS 2002a). However, these fish species are likely extirpated from the Colorado River system above Flaming Gorge Dam on the Green River (Baxter and Stone 1995). None of these four endangered fish species is likely to be found in streams and tributaries within the project area. However, the potential for project-related impacts (water quality or quantity reduction) to waters that feed into the Green River warrant their inclusion in this NEPA document.

Bonytail. Habitat of the bonytail is primarily limited to narrow, deep canyon-bound rivers with swift currents and white water areas (Valdez and Clemmer 1982, Archer et al. 1985, Upper Colorado River Endangered Fish Recovery Program 2002). Little is known about the specific habitat requirements of bonytail but it is thought that flooded bottomland habitats are

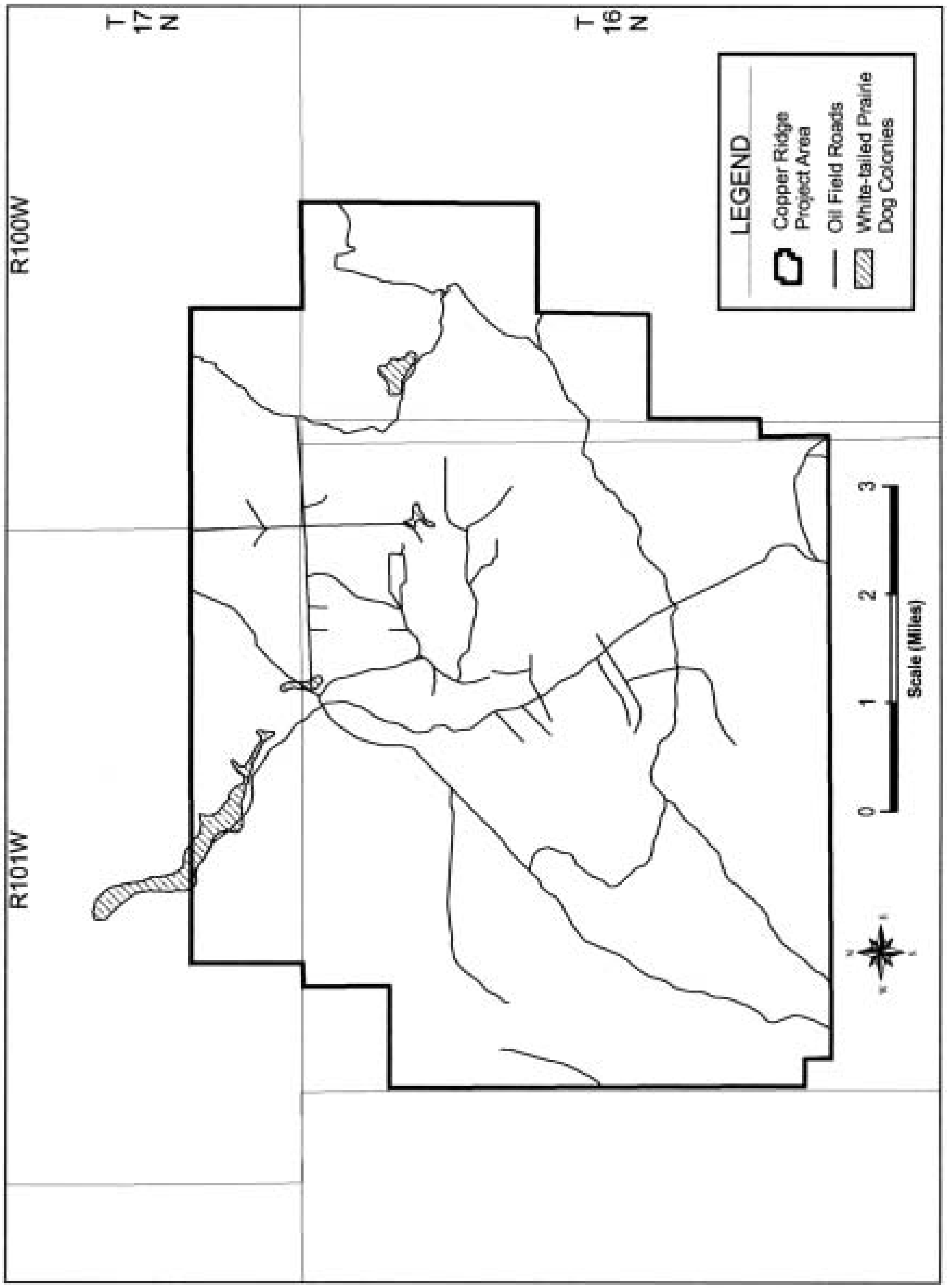


Figure 3-12. White Tailed Prairie Dog Colonies in Relation to the CRPA.

important nursery and growth areas for young. Adults reach a maximum size of 550 mm (21.7 in) in length and 1.1 kg (2.4 lbs) in weight (USDI-FWS 2002b). With no known reproducing populations in the wild, the bonytail is thought to be the rarest of the endangered fishes in the Colorado River Basin. The bonytail was historically found in portions of the upper and lower Colorado River basins. Today, in the upper Colorado River Basin, only small, disjunct populations of bonytail are thought to exist in the Yampa River in Dinosaur National Monument, in the Green River at Desolation and Gray canyons, and in the Colorado River at the Colorado/Utah border and in Cataract Canyon (Upper Colorado River Endangered Fish Recovery Program 2002).

Colorado Pikeminnow. The Colorado pikeminnow is the largest member of the minnow family and occurs in swift, warm waters of Colorado Basin rivers. Adults attain a maximum size of approximately 1.8 meters (5.9 feet) in length and 36 kg (79.4 lbs) in weight (USDI-FWS 2002c). The species is adapted to rivers with seasonally variable flow, high silt loads, and turbulence. Pools and eddies outside the main current are used by adult pikeminnow. Backwater areas are inhabited by young-of-the-year. The species was once abundant in the main stem of the Colorado River and most of its major tributaries throughout Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, California, and Mexico. Today the species is primarily limited to the Green River below its confluence with the Yampa River; the lower Duchesne River in Utah; the Yampa River below Craig, Colorado; the White River from Taylor Draw Dam near Rangely, downstream to the confluence with the Green River; the Gunnison River in Colorado; and the Colorado River from Palisade, Colorado, downstream to Lake Powell (Upper Colorado River Endangered Fish Recovery Program 2002); and there are small numbers of wild individuals, with limited reproduction, in the San Juan River subbasin. The Colorado pikeminnow has been reintroduced into the Gila River subbasin, where it exists in small numbers in the Verde River (USDI-FWS 2002c).

Humpback Chub. Humpback chub are restricted to deep, swift, canyon regions of the mainstem and large tributaries of the Colorado River Basin. Adults attain a maximum length of 480mm (18.9 in) and 1.2 kg (2.6 lbs) in weight (USDI-FWS 2002d). Historically, the humpback chub inhabited the canyons of the Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado rivers. Now, two relatively stable populations are found in Westwater Canyon, Utah and Black Rocks, Colorado. Smaller numbers have been found in the Yampa and Green Rivers in Dinosaur National Monument, Desolation and Gray canyons on the Green River in Utah, Cataract Canyon on the Colorado River in Utah, and the Colorado River in Arizona. The largest known population is in the Little Colorado River in the Grand Canyon, where there may be up to 10,000 fish. There are no population estimates available for the rest of the upper Colorado River Basin (Upper Colorado River Endangered Fish Recovery Program 2002).

Razorback Sucker. The razorback sucker, an omnivorous bottom feeder, is one of the largest fishes in the sucker family reaching a length of 1 meter (3.3 ft) in length and 5-6 kg (11-13 lbs) in weight (USDI-FWS 2002e). Adult razorback sucker habitat use varies depending on season and location. Adults are adapted for swimming in swift currents, but they may also be found in eddies and backwaters away from the main current. Young require nursery habitats consisting of quiet, warm, shallow water, such as backwaters or inundated floodplains, river tributary mouths, and coves and shorelines in reservoirs (USDI-FWS 2002e). This species was once widespread throughout most of the Colorado River Basin from Wyoming to Mexico. Today, in the upper Colorado River Basin, populations of razorback suckers are only found in the upper Green River in Utah, the lower Yampa River in Colorado and occasionally in the Colorado River near Grand Junction. Small numbers of razorback suckers have also been found in Lake Powell, San Juan River, and Colorado River (Upper Colorado River Endangered Fish Recovery Program 2002).

3.8.1.4 Plant Species

Ute ladies'-tresses. The Ute ladies'-tresses (*Spiranthes diluvialis*), a threatened species, is a perennial, terrestrial orchid, endemic to moist soils near wetland meadows, springs, lakes, and perennial streams. It occurs generally in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows at elevations from 4,200 to 7,000 feet. The orchid colonizes early successional riparian habitats such as point bars, sand bars, and low-lying gravelly, sandy, or cobbly edges, persisting in those areas where the hydrology provides continual dampness in the root zone through the growing season. It is known to occur in a number of locations in Daggett County, Utah, with the closest being about 39 miles south of the project area and also along the Snake River in Idaho. Because potential habitat for the plant is present in Sweetwater County, the FWS requires the BLM to conduct field surveys for its presence to satisfy NEPA requirements for EAs and EISs. The probability of suitable habitat for this species occurring on the CRPA is very low. The BLM has made a "no effect" determination; thus, this species will not be given further consideration in this document.

3.8.2 Sensitive Wildlife, Fish, and Plant Species

Although these species have no legal protection under the ESA, the BLM and FWS still maintain an active interest in their numbers and status. Sensitive species are those included on the BLM Wyoming State sensitive species list (USDI-BLM 2002). The BLM views "management of sensitive species as an opportunity to practice pro-active conservation; this management should not be onerous, or a show-stopper of other legitimate, multiple use activities" (USDI-BLM 2002). The BLM Wyoming Sensitive Species list is meant to be dynamic, and the list will be reviewed annually. The plant, wildlife, and fish species and their sensitivity status/rank are listed in Table 3-10. A summary discussion of these species follows. In addition, the RSFO identified several of these species to be considered in more detail.

3.8.2.1 Mammals

Nine sensitive mammal species may potentially be found on the CRPA (USDI-BLM 2002, Table 3-5). These include: Idaho pocket gopher, Wyoming pocket gopher, pygmy rabbit, white-tailed prairie dog, swift fox, spotted bat, fringed myotis, long-eared myotis, and Townsend's big-eared bat. The RSFO identified four of these species that should be considered in more detail: swift fox, Wyoming pocket gopher, pygmy rabbit, and white-tailed prairie dog.

Swift Fox. The swift fox inhabits short grass and mid-grass prairies over most of the Great Plains including eastern Wyoming (Clark and Stromberg 1987). The swift fox commonly prefers areas with relatively flat to gently rolling topography (Fitzgerald et al. 1994, Olson 2000). Swift foxes prey on a variety of small rodents, lagomorphs, birds, and insects (Cutter 1958, Olson 2000). This species has been studied in Wyoming (Olson 2000), and recent surveys conducted by Woolley et al. (1995) show that it is much more widely distributed in Wyoming than previously thought. Woolley's studies have documented occurrences in northeastern Sweetwater County but his study area did not include the Copper Ridge Project Area in southern Sweetwater County.

No records of swift fox were documented in the WOS (WGFD 2002c) or WYNDD (WYNDD 2002) within six miles of the project area. Although the majority of the project area is not ideal habitat, some portions of the project area may provide limited foraging habitat for swift fox.

Wyoming Pocket Gopher. Little is known about the Wyoming pocket gopher. The species is the only mammal restricted to Wyoming, and the only known populations occur in the south-central portion of the state (Clark and Stromberg 1987).

Like all pocket gophers, the Wyoming pocket gopher spends most of its life underground. The species is frequently found along dry ridge tops and is associated with gravelly, loose soils and greasewood vegetation communities (*Sarcobatus* spp.) (Clark and Stromberg 1987). Within these habitats, the Wyoming pocket gopher digs two types of tunnels: (1) deep burrows with chambers used for shelter, nesting, food storage, and deposition of fecal material, and (2) long, winding, and shallow tunnels used to forage for roots, tubers, and other vegetation material from above (Nowak 1999). The shallow food tunnels are often visible from the ground surface and are useful in detecting the presence of pocket gophers. The limited behavioral information available on the species suggests that except during the breeding season, Wyoming pocket gophers lead solitary lives with only one individual per burrow system (Nowak 1999).

Limited potential habitat exists within the project area for Wyoming pocket gophers. Although the species has not been documented within a six-mile radius of the project area (WGFD 2002c, WYNDD 2002), its fossorial behavior makes the Wyoming pocket gopher difficult to detect.

Pygmy Rabbit. The former range of the pygmy rabbit was thought to be limited to portions of Idaho and Utah until their presence was confirmed in southwest Wyoming (Campbell et al. 1982). Pygmy rabbit sightings were documented by HWA in1994 south of Fontenelle Reservoir in eastern Lincoln and western Sweetwater Counties (HWA 1994). Pygmy rabbits are limited to areas of dense and tall big sagebrush in predominantly sandy soils (Campbell et al. 1982, Clark and Stromberg 1987, Heady et al. 2002). Burrows are located in areas with greater cover, higher shrub density, taller vegetation, and greater forb cover (Heady et al. 2002).

No pygmy rabbit records within six miles of the project area were documented in the WOS (WGFD 2002c) or the WYNDD (WYNDD 2002). The project area is primarily dominated by Wyoming big sagebrush and it is possible that pygmy rabbits could occur on the project area.

3.8.2.2 Birds

Thirteen sensitive bird species may potentially be found on the CRPA (USDI-BLM 2002, Table 3-5). These include: mountain plover, sage sparrow, Brewer's sparrow, long-billed curlew, sage thrasher, western burrowing owl, loggerhead shrike, greater sage-grouse (See Section 3.7.6), white-faced Ibis, trumpeter swan, peregrine falcon, ferruginous hawk, and northern goshawk. The RSFO requested that the mountain plover, sage thrasher, loggerhead shrike, Brewer's sparrow, sage sparrow, and burrowing owl be considered in more detail.

Mountain Plover. The mountain plover nests over much of Wyoming, but its preferred habitat may be limited throughout its range in the state (Oakleaf et al. 1982, Dinsmore 1983, Leachman and Osmundson 1990). This ground-nesting species is typically found in areas of short (less than four inches) vegetation on slopes of less than three percent. Any short grass, very short shrub, or cushion plant community could be considered plover nesting habitat (Parrish et al. 1993), however, mountain plovers prefer shortgrass prairie with open, level or slightly rolling

Table 3-10. Sensitive Wildlife, Fish, and Plant Species Potentially Present in the CRPA.[1]

Wildlife Species			
Common Name	**Scientific Name**	**Sensitivity Status[2]**	**Occurrence Potential[3]**
Mammals			
Idaho pocket gopher	*Thomomys idahoensis*	G4/S2?, NSS3	Unlikely
Wyoming pocket gopher	*Thomomys clusius*	R2, G2/S1S2, NSS4	Likely
Pygmy rabbit	*Brachylagus idahoensis*	G4/S2, NSS3	Possible
White-tailed prairie dog	*Cynomys leucurus*	G4/S2S3, NSS3	Present
Swift fox	*Vulpes velox*	R2, G3/S2A3	Possible
Spotted bat	*Euderma maculatum*	R2/R4,G4/S1B, SZ?N, NSS2	Unlikely
Fringed myotis	*Myotis thysanodes*	R2, G5/S1B, S1N, NSS2	Unlikely
Long-eared myotis	*Myotis evotis*	G5/S1B, S1?N, NSS2	Unlikely
Townsend's big-eared bat	*Corynorhinus townsendii*	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Birds			
Mountain Plover	*Charadrius montanus*	G2/S2B,SZN	Unlikely
Sage Sparrow	*Amphispiza belli*	G5/S3B, SZN	Possible
Brewer's Sparrow	*Spizella breweri*	G5/S3B, SZN	Possible
Long-billed Curlew	*Numenius americanus*	G5/S3B, SZN, R2, NSS3	Unlikely
Sage Thrasher	*Oreoscoptes montanus*	G5/S3B, SZN	Likely
Western Burrowing Owl	*Athene cunicularia*	R2, G4/S3B, SZN, NSS4	Possible
Loggerhead Shrike	*Lanius ludovicianus*	G5/S4B, SZN, R2	Likely
greater sage-grouse	*Centrocercus urophasianus*	G5/S3	Present
White-faced Ibis	*Plegadis chihi*	G5/S1B, SZN, R2, NSS3	Unlikely
Trumpeter Swan	*Cygnus buccinator*	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Peregrine Falcon	*Falco peregrinus*	G4/T3/S1B, S2N, R2, NSS3	Unlikely
Ferruginous Hawk	*Buteo regalis*	R2, G4/S3B, S3N, NSS3	Present
Northern Goshawk	*Accipiter gentilis*	R2/R4, G5/S23B, S4N, NSS4	Unlikely
Reptiles			
Midget-faded rattlesnake	*Crotalus viridis concolor*	G5T3/S1S2	Unlikely
Amphibians			
Boreal toad	*Bufo boreas boreas*	G4T4/S2, R2, R4, NSS2	Unlikely
Great Basin spadefoot toad	*Spea intermontanus*	G5/S4, NSS4	Possible
Northern leopard frog	*Rana pipiens*	G5/S3, R2, NSS4	Unlikely
Spotted frog	*Rana pretiosa*	G4/S2S3, R2, R4, NSS4	Unlikely
Fish			
Leatherside chub	*Gila copei*	G3G4/S2, NSS1	Unlikely
Roundtail chub	*Gila robusta*	G2G3/S2?, NSS1	Unlikely
Bluehead sucker	*Catostomus discobolus*	G4/S2S3, NSS1	Unlikely
Flannelmouth sucker	*Catostomus latipinnis*	G3G4/S3, NSS1	Unlikely
Colorado River cutthroat trout	*Oncorhynchus clarki pleuriticus*	R2/R4, G4T2T3/S2, NSS2	Unlikely

Table 3-10. Sensitive Wildlife, Fish, and Plant Species Potentially Present in the CRPA.[1]

Plant Species				
Common Name	**Scientific Name**	**Sensitivity Status[2]**	**Habitat**	**Occurrence Potential[3]**
Meadow pussytoes	*Antennaria arcuata*	GS/S2	Moist, hummocky meadows, seeps or springs surrounded by sage/grasslands 4,950-7,900'	low
Small rock cress	*Arabis pusilla*	G1/S1 Removed from Federal Candidate list 10/25/99	Cracks/crevices in sparsely vegetated granite/pegmalile outcrops within sage/grasslands 8,000-8,100'	low
Mystery wormwood	*Artemisia biennis var. diffusa*	G5T1/S1	Clay flats and playas 6,500'	low; known-private land ownership
Nelson's milkvetch	*Astragalus nelsonianus*	G2/S2 CO	Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities at 5,200-7,600'	low
Precocious milkvetch	*Astragalus proimanthus*	G1/S1, BLM	Cushion plant communities on rocky, clay soils mixed with shale on summits and slopes of white shale hills at 6,800-7,200 feet.	low
Cedar Rim thistle	*Cirsium aridum*	G2Q/S2	Barren, chalky hills, gravelly slopes and fine textured, sandy-shaley draws 6,700-7.200'	possible
Ownbey's thistle	*Cirsium ownbeyi*	G3/S2	Sparsely vegetated shaley slopes in sage and juniper communities 6,440-8,400;	low
Wyoming tanseymustard	*Descurania torulosa*	G1/S1	Sparsely vegetated sandy slopes at base of cliffs of volcanic breccia or sandstone 8,300-10,000'	low
Large-fruited bladderpod	*Lesquerella macrocarpa*	G2/S2	Gypsum-clay hills and benches, clay flats, and barren hills 7,200-7,700'	low
Stemless beardtongue	*Penstemon acaulis var. acaulis*	G3T2/S1	Cushion plant or black sage grassland communities on semi-barren rocky ridges, knolls, and slopes at 6,500-7,000'	low
Beaver Rim phlox	*Phlox pungens*	G2/S2	Sparsely vegetated slopes on sandstone, siltstone, or limestone substrates 6,000-7,600'	possible
Tufted twinpod	*Physaria condensata*	G2/S2	Sparsely vegetated shale slopes and ridges 6,500-7,000''	possible
Green River greenthread	*Thelesperma caespitosum*	G1/S1	White shale slopes and ridges of Green River Formation 6,300'	low
Uinta greenthread	*Thelesperma pubescens*	G1/S1 FSR4	Sparsely vegetated benches and ridges on coarse, cobbly soils of Bishop Conglomerate 8,500'	low
Cedar Mountain Easter daisy	*Townsendia mircrocephala*	G1/S1	Rocky slopes of Bishop Conglomerate 8,500'	low

[1] - Source: USDI-BLM (2002), WYNDD (2002), WGFD (2002).
[2] - Definition of status

G Global rank: Rank refers to the range-wide status of a species.
T Trinomial rank: Rank refers to the range-wide status of a subspecies or variety.
S State rank: Rank refers to the status of the taxon (species or subspecies) in Wyoming. State ranks differ from state to state.
1 Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.
2 Imperiled because of rarity (often known from 6-20 occurrences) or because of factors demonstrably making a species vulnerable to extinction.
3 Rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).
4 Apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
5 Demonstrably secure, although the species may be rare in parts of its range, especially at the periphery.
H Known only from historical records. 1950 is the cutoff for plants; 1970 is the cutoff date for animals.
X Believed to be extinct.
A Accidental or vagrant: A taxon that is not known to regularly breed in the state or which appears very infrequently (typically refers to birds and bats).
B Breeding rank: A state rank modifier indicating the status of a migratory species during the breeding season (used mostly for migratory birds and bats)
N Nonbreeding rank: A state rank modifier indicating the status of a migratory species during the non-breeding season (used mostly for migratory birds and bats)
ZN or ZB Taxa that are not of significant concern in Wyoming during breeding (ZB) or non-breeding (ZN) seasons. Such taxa often are not encountered in the same locations from year to year.
U Possibly in peril, but status uncertain; more information is needed.
Q Questions exist regarding the taxonomic validity of a species, subspecies, or variety.
? Questions exist regarding the assigned G, T, or S rank of a taxon.
R2 Designated sensitive in U.S. Forest Service Region 2 (Rocky Mountain Region).
R4 Designated sensitive in U.S. Forest Service Region 4 (Intermountain Region).

<u>WGFD Native Species Status Codes - Fish and Amphibians</u>

NSS1 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitats are declining or vulnerable. Extirpation appears possible. The Wyoming Game and Fish Commission mitigation category for Status 1 species is "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.
NSS2 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitat conditions appear to be stable. The Wyoming Game and Fish Commission mitigation category for Status 2 species is also "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.
NSS3 - Populations are widely distributed throughout its native range and appear stable. However, habitats are declining or vulnerable. The Wyoming Game and Fish Commission mitigation category for Status 3 species is "High". The mitigation objective for this resource category is to realize "no net loss of habitat function within the biological community which encompasses the project site". Under these guidelines, it will be important that the project be conducted in a manner that either avoids the impact, enhances similar habitat or results in the creation of an equal amount of similarly valued fishery habitat.
NSS4-7 - Populations are widely distributed throughout native range and are stable or expanding. Habitats are also stable. There is no special concern for these species.
<u>WGFD Native Species Status Codes - Birds and Mammals</u>
NSS1 - Populations are greatly restricted or declining, extirpation appears possible. AND On-going significant loss of habitat.
NSS2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; ongoing significant loss of habitat.
NSS3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is restricted or vulnerable but no recent or on-going

significant loss; species may be sensitive to human disturbance. OR Species is widely distributed; population status or trends are unknown but are suspected to be stable; on-going significant loss of habitat.
NSS4 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance.
NSS5 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is stable and not restricted. OR Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.
NSS6 - Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is stable and not restricted.
NSS7 - Populations are stable or increasing and not restricted in numbers and/or distribution; habitat is stable and not restricted.

[3] - Occurrence potential based upon presence of habitat, known distribution, and personal communications with RSFO biologists J. Dunder (wildlife) and J. Glennon (botany).

areas dominated by blue grama and buffalograss (Graul 1975, Dinsmore 1981, Dinsmore 1983, Kantrud and Kologiski 1982). These habitats are quite often associated with prairie dog colonies, and researchers have found that plovers use prairie dog colonies more often than other areas (Knowles et al. 1982, Knowles and Knowles 1984, Olson and Edge 1985). Loss of wintering and breeding habitats and prey-base declines from pesticide use are thought to be factors contributing to the decline of mountain plovers on the North American Continent (Wiens and Dyer 1975, Knopf 1994).

No mountain plover records within the 6-mile buffer of the project area were reported in the WOS (WGFD 2002c) or WYNDD (WYNDD 2002). While not providing ideal mountain plover habitat, some portions of the project area provide limited nesting opportunities for mountain plovers. Areas providing potential mountain plover habitat were mapped from the ground by HWA on April 29 and May 1, 2003. Several small habitat patches, covering a total of 245.6 acres were found in the north central portion of the CRPA (Figure 3-13). Surveys were then conducted to determine mountain plover presence or absence in these habitat patches. Survey protocol followed the USFWS guidelines (USDI-FWS 2002), which require that three surveys be conducted between May 1 and June 15, with each survey being separated by at least 14 days. The three surveys were conducted on May 1, May 30, and June 13, 2003; no mountain plovers were observed in any of the potential habitats located on the CRPA.

Sage Thrasher. The sage thrasher generally occurs within shrub-dominated valleys and plains of the western United States and is considered a sagebrush (*Artemesia* spp.) obligate. Insects are the primary food source and foraging occurs almost exclusively on the ground. For successful breeding, the Sage Thrasher requires large patches of sagebrush steppe habitat and typically nests in taller shrubs with wider crowns (Reynolds et al. 1999).

Suitable habitat exists in the area with 10 records of sage thrashers occurring within six miles of the project area (WGFD 2002c). It is likely that sage thrashers use the larger patches of taller sagebrush within the project area.

Loggerhead Shrike. The loggerhead shrike is a small avian predator that hunts from perches and impales its prey on thorns, barbed wire fences, and other sharp objects (Yosef 1996). It prefers open country within close proximity to brushy areas containing trees or shrubs taller than six feet for nesting (Dinsmore 1983). It breeds in basin-prairie shrublands, sagebrush grasslands, mountain-foothills shrublands, pine-juniper woodlands, and woodland chaparral. Nests are located 1-5 feet above the ground regardless of shrub height. The loggerhead shrike feeds primarily on grasshoppers and other large insects although some small mammals and birds are also taken. Areas of low vegetation or bare ground are preferred foraging habitat (Cerovski et al. 2001).

Two records of loggerhead shrikes are documented within six miles of the project area (WGFD 2002c) and it is likely that loggerhead shrikes utilize portions of the project area during the nesting season.

Brewer's Sparrow. Most Brewer's sparrows breed in the Great Basin area of the western United States and winter in the Sonoran and Chihuahuan deserts of southwestern United States and Mexico (Rotenberry et al. 1999). Breeding habitat is closely associated with landscapes dominated by Wyoming big sagebrush with an average nest - shrub height of 0.5 meters. Nests are located less than 1.2 meters high in live sagebrush or on the ground at the base of a live sagebrush shrub. The Brewer's sparrow is a common cowbird host and parasitized nests are sometimes deserted (Cerovski et al. 2001).

Eight records of Brewer's sparrows are documented within six miles of the project area (WGFD 2002c, WYNDD 2002). It is likely that Brewer's sparrows breed within the sagebrush habitats that exist on the project area.

Sage Sparrow. The sage sparrow prefers semi-open habitats with evenly spaced shrubs 1-2 meters high. Although closely associated with Wyoming big sagebrush, the sage sparrow will utilize sagebrush communities interspersed with other shrub species, such as bitterbrush (*Purshia tridentata*), saltbush (*Atriplex* spp.), shadscale (*Atriplex confertifolia*), rabbitbrush (*Chrysothamnus* spp.), or greasewood (Martin and Carlson 1998). Sage sparrows nest in shrubs up to one meter high and require a large block of unfragmented habitat to breed successfully (Cerovski et al. 2001).

No records of sage sparrows are documented within six miles of the project area (WGFD 2002c, WYNDD 2002). The project area is dominated by Wyoming big sagebrush and it is possible that sage sparrows occur on the project area.

Burrowing Owl. The burrowing owl is a summer resident on the plains over much of Wyoming and usually arrives on its breeding grounds from late March to mid-April (Johnsgard 1986, Haug et al. 1993). The species is associated with dry, open habitat that has short vegetation and contains an abundance of burrows (Thomsen 1971, Wedgwood 1978, Haug et al. 1993). In Wyoming, prairie dog burrows are the most important source of burrowing owl nest sites. Burrowing Owl use of abandoned prairie dog towns is minimal, and active prairie dog towns are their primary habitat (Butts 1973). Destruction of burrowing mammal habitat that the birds depend on, pesticides, predators, and vehicle collisions have all combined to cause a decline in

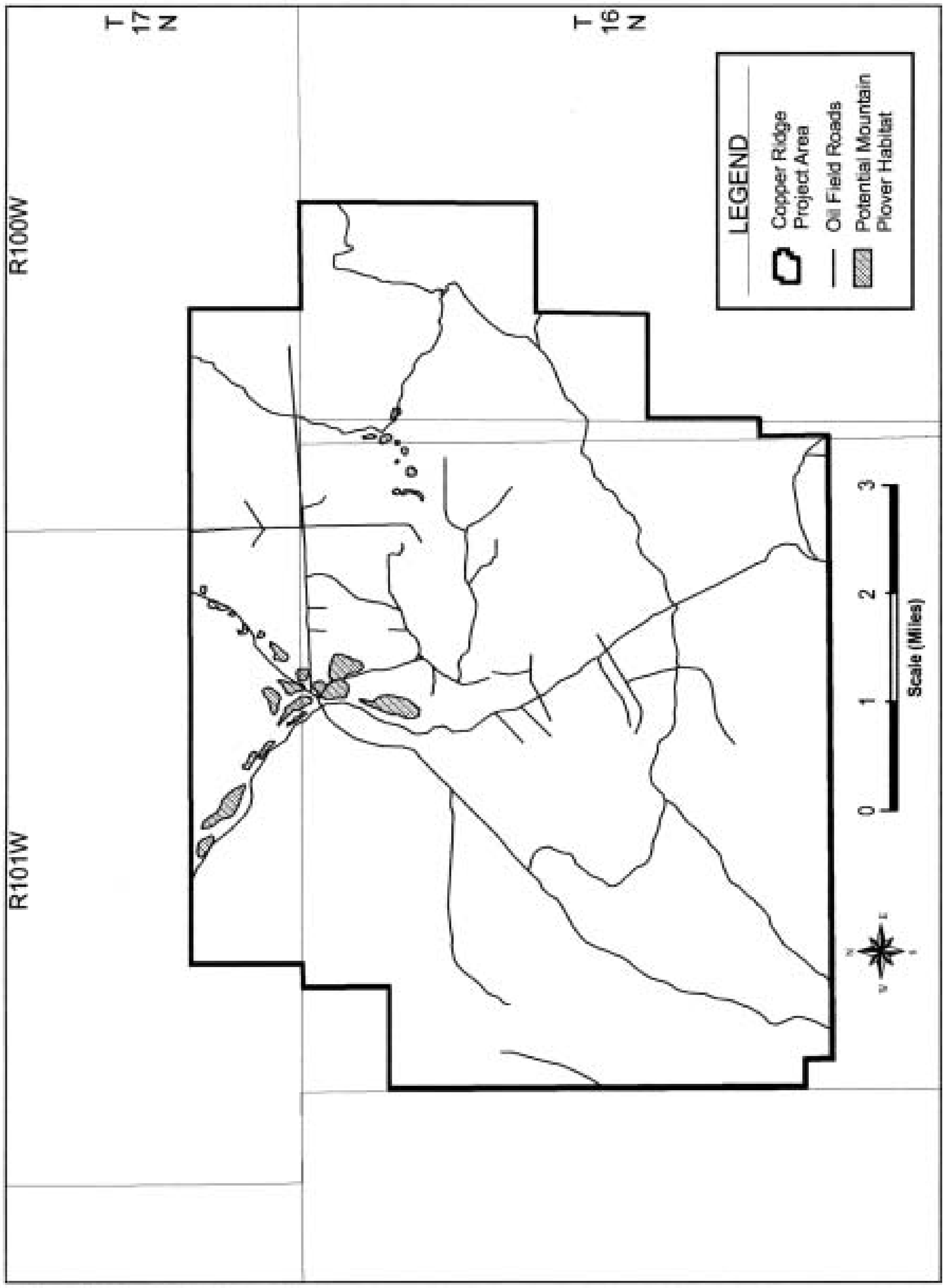


Figure 3-13. Areas Identified as Potential mountain plover Habitat on the CRPA.

burrowing owl numbers (Haug et al. 1993).

No burrowing owl sightings have been documented within six miles of the project area (WGFD 2002c, WYNDD 2002), however the presence of prairie dog colonies may provide adequate nesting habitat for burrowing owl use.

3.8.2.3 Reptiles

No records of midget-faded rattlesnakes are documented within six miles of the project area (WGFD 2002c, WYNDD 2002). Although included in BLM's sensitive species list (USDI-BLM 2002, Table 3-5), the likelihood that the midget-faded rattlesnake occurs on the CRPA is very low.

3.8.2.4 Amphibians

Four sensitive amphibian species may potentially be found on the CRPA (USDI-BLM 2002, Table 3-5). The boreal toad, northern leopard frog, and spotted frog are unlikely to occur on the CRPA; the Great Basin spadefoot toad has a slight potential to occur.

Great Basin Spadefoot Toad. In Wyoming, the Great Basin spadefoot occurs in sagebrush communities mostly west of the Continental Divide (Baxter and Stone 1980). They are dormant in fall and winter and their emergence in spring may be triggered by moisture in the burrow. Spadefoots may extend their dormancy period during drought for long periods of time. Breeding occurs during spring and early summer in permanent and temporary waters, including playas that develop after heavy rains and spring runoff pools. Males usually emerge from burrows after spring rains to breed, although Great Basin spadefoots do breed during periods of no rain. The stimulus for emergence for breeding in the absence of rain is unknown. Adult spadefoots are opportunistic carnivores and emerge from their burrows at night to forage for insects, arachnids, and snails only when the air is humid enough for dew to collect or during light rains (Howard 1996).

The Great Basin spadefoot has not been documented within six miles of the project area (WGFD 2002c, WYNDD 2002). Although limited habitat exists in the area it is possible that Great Basin spadefoots occur on the project area and utilize the intermittent and temporary water sources for breeding during years with adequate moisture.

3.8.2.5 Fish

Five sensitive fish species may potentially be found downstream of the CRPA. These include: leatherside chub, roundtail chub, bluehead sucker, flannelmouth sucker, and Colorado River cutthroat trout. These species are unlikely to occur on the CRPA due to a lack of suitable habitat. However, they do occur downstream of the CRPA and are therefore considered in this document.

3.8.2.6 Plants

Sixteen BLM Wyoming state sensitive plant species are found in the RSFO Area (USDI-BLM 2002). Table 3-10 provides a listing of these species, habitat needs, and their potential to occur within the project area. Of these species, three have the potential to occur in the project area: Cedar Rim thistle (*Cirsium radium*), Beaver Rim phlox (*Phlox pungens*), and tufted twinpod

(*Physaria condensata*).

Cedar Rim Thistle. This thistle can be found on barren, chalky hills, gravelly slopes, and fine-textured, sandy shaley draws between 6,700 and 7,200 ft.

Beaver Rim Phlox. Beaver Rim phlox prefers sparely vegetated slopes on sandstone, siltstone, or limestone substrates at elevations between 6,000 and 7,000 ft.

Tufted Twinpod. Tufted twinpod occurs in sparsely vegetated slopes and ridges between 6,500 and 7,000 ft.

3.8.3 Migratory Birds

The Copper Ridge Project area is mixed sagebrush steppe and pinon-juniper habitat. A wide variety of landscape features also add to the diversity of bird species found within the analysis area. Small rock outcrops associated with low escarpments provide suitable nesting habitat for rock wrens, while pinon jays, western bluebirds, tits and warblers can be found among the junipers.

Found within the sagebrush steppe habitat are sage thrasher, white-crowned sparrow, northern shrike and horned lark. Because the area consists of tall sagebrush communities, mid and low sagebrush, cushion plant communities, grassy meadows and greasewood bottoms, the avifauna is widely diverse. A few man-made perennial waters hold many of these species throughout the dry summer.

As the season changes to winter and temperatures fall, avian species inhabiting the area change. Flocks of snow bunting, horned larks, grey-crowned rosy finch and McCowen's longspur can be found foraging gravel along roadways. Northern harriers also winter here, foraging for cottontail and small rodents.

3.9 VISUAL RESOURCES

The CRPA is located in within the Wyoming Basin physiographic province. The topography of the area is highly variable, ranging from relatively flat areas to rolling hills, carved by numerous drainages. In the distance are desert mountains with steep sideslopes cliffs and canyons. Two prominent features to the southeast, Sand Butte and Pine Butte, can be seen in the distance from certain locations within the CRPA. Additionally, views of ridges, rims and draws are available from different locations within and near the project area. Cultural modifications in and near the CRPA include extensive oil and gas field development (roads, well pads, wellhead facilities and a processing plant), primarily in the north central and northeastern portions of the project area, although two-track roads and scattered drilling locations are can be seen elsewhere in the CRPA.

According to the GRRMP, the region which contains the CRPA has been designated as Visual Resource Management (VRM) Class IV, which allows for major modification of the character of the landscape, with appropriate mitigation measures to reduce visual impacts. However, the northeast portion of the CRPA lies within an area that has been designated as a VRM rehabilitation area, which means that the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the higher classifications (USDI-

BLM 1996). Visual resource rehabilitation is required because historic oil and gas development in the area has resulted in substantial disturbance, including a number of two-track short-cut roads. It is a BLM VRM objective to reclaim areas of unnecessary disturbance within the existing Brady and Jackknife Spring fields, effectively rehabilitating the area to VRM Class IV (Deakins 2003).

3.10 RECREATION

Recreation resources in and near the CRPA are limited to dispersed recreation activities, primarily hunting (antelope, deer, sage grouse and small game). There are no special recreation management areas, designated recreation use areas, scenic or historic trails or developed recreation facilities in or adjacent the CRPA. The CRPA and immediately adjacent areas are believed to receive limited recreational use, primarily because of the existing oil and gas development and associated operations and maintenance activities (Foster 2003). Sweetwater County and BLM roads within the CRPA provide access to less disturbed areas to the south and southwest of the project area and some recreationists may cross the CRPA on their way to and from these areas.

3.11 CULTURAL AND HISTORIC RESOURCES

Management Objectives

The objectives for the management of the cultural and paleontological resources are to:

- Expand the opportunities for scientific study, and educational and interpretive uses of cultural and paleontological resources;
- protect and preserve important cultural and paleontological resources and/or their historic record for future generations; and
- resolve conflicts between cultural/paleontological resources and other resource uses.

Of particular concern are significant sites of historic or prehistoric human habitation, sites demonstrating unique ethnic affiliation, places having traditional cultural significance to Native Americans, and vertebrate fossil localities (USDI 1997).

3.11.1 Cultural Chronology of Area

Archaeological investigations in the Green River Basin indicate the area has been inhabited by prehistoric people for at least 10,000 years from Paleoindian occupation to the present. The accepted cultural chronology is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The Wyoming Basin prehistoric chronology is documented in Table 3-11. Not all of the sites discussed below are located in the project area.

Table 3-11. Prehistoric chronology of the Wyoming Basin.

Period	Phase	Age (YBP)
Paleoindian		12,000 - 8500
Early Archaic	Great Divide	8500 - 6500
	Opal	6500 - 4300
Late Archaic	Pine Spring	4300 - 2800
	Deadman Wash	2800-2000/1800
Late Prehistoric	Uinta	2000/1800 - 650
	Firehole	650 - 300/250
Protohistoric		300/250 - 150

from Metcalf (1987), as modified by Thompson and Pastor (1995)
YBP is years before present

Paleoindian Period

The oldest period for which there is solid archaeological evidence is the Paleoindian, beginning ca. twelve thousand years before present (YBP) and ending around 8500 YBP. This is the transition period from the periglacial conditions of the Wisconsin ice advance during the terminal Pleistocene to the warmer and drier climatic conditions of the Holocene. A savanna-like environment with higher precipitation than occurs today was prevalent in southwest Wyoming. Archaeological research has focused on understanding paleoenvironmental conditions operating at the end of the Pleistocene and into the Holocene to provide insights into the articulation between human populations and the environment (Thompson and Pastor 1995). Paleoindian sites are rare in southwest Wyoming. However, isolated surface finds of Paleoindian projectile points are not uncommon and suggest that site preservation or visibility may be factors affecting the number of known sites. The Paleoindian tool assemblage includes lanceolate points, gravers, and end-scrapers.

Archaic Period

Settlement and subsistence practices, in southwest Wyoming, remained largely unchanged from the end of the Paleoindian period through the Archaic and continued until at least the introduction of the horse, or even until Historic Contact. Reduced precipitation and warmer temperatures occurred ca. 8500 YBP. The environmental change at the end of the Paleoindian period led to a pattern of broad-spectrum resource exploitation, which is reflected in the more diverse subsistence and settlement practices of the Archaic period.

The Archaic period is divided into the Early and the Late periods and subdivided in the Great Divide and Opal and the Pine Spring and Deadman Wash phases, respectively. Large side- and corner-notched dart points used for hunting are temporally diagnostic artifacts of the Archaic period. The earliest dated occurrence of side-notched points are Component I at the Maxon Ranch site, located west of the project area, dating between 6400 - 6000 YBP (Harrell and McKern 1986). Large side-notched points from the Great Basin and Colorado Plateau occur as early as 7000 years YBP. The presence of ground stone implements suggests a greater use of plant resources during the Archaic period. Faunal assemblages from Archaic period components document increased use of small animals (Thompson and Pastor 1995).

Slab-lined features and housepits are also prevalent during this period.

Examples of two sites located in the area surrounding the Copper Ridge project area that contain Archaic components include Sites 48SW97 and 48SW5175. Site 48SW97 is a multi-component campsite located northwest of the study area. Component II dated to 2600"110 B. P. and contained evidence of processing and preparation of one or more medium to large-sized animal and limited tool manufacture and tool maintenance (McNees et al.1992). Site 48SW5175 is a multi-component Archaic site dating between 5220 and 3770 B. P. located west/northwest of the project area. The site represents residential occupation evidenced by housepits in Components I and II with tool manufacture and maintenance centered at the hearths. Slab-lined features were documented in Component III (Newberry and Harrison 1986).

Late Prehistoric Period

The Late Prehistoric period is between 2000 - 250 YBP and is subdivided into the Uinta and the Firehole phases. Large-scale seed processing and an increase in the number of features is noted in the Late Prehistoric period, as is the presence of pottery and the introduction of the bow and arrow technology. A characteristic of the Uinta phase is clusters of semi-subterranean structures dating to ca. 1500 YBP.

Two sites in the region represent Uinta phase occupation. Component III at Site 48SW97 (McNees et al. 1992) returned a radiocarbon date of 1460"70 B. P. and is a single occupation exhibiting projectile point manufacture, tool maintenance, and a domestic activity/work area. Seed processing, meat processing, and bone processing of medium and large mammal bone was also noted. Hearth styles included a deep, steep-sided oxidized basin hearth, a shallow basin hearth, and a deep basin hearth. Site 48SW270 (McNees et al. 1992) is located in stabilized sand dunes. The Uinta phase site contained a tri-hearth complex, Rose Spring points, an oxidized cylindrical basin, bone tube manufacture, and seed processing. Two separate but distinct occupations with reuse of features and activity areas were identified.

Two sites located west of the study area date to the transition period between the Uinta phase and the Firehole phase of the Late Prehistoric period. Component IV at Site 48SW97 dates from 940 to 670 B. P. The single component contains multiple occupations. Artifacts include tri-notched projectile pints, side-notched points, fingernail-incised ceramics, and procurement of large mammals at the site. A sandstone cobble incised with an apparent anthropomorphic figure and a fragment of a ceramic tube were also recovered from the component (McNees et al. 1992). Another transition period site is Site 48SW5377 dating to 980"90 B. P. The site is a late summer to early fall, short-term camp located in a dune. Results of the analysis of the floral and faunal remains indicate that floral processing was the more important. Rose Spring points and a clay animal figurine possibly a mountain sheep or pronghorn with holes incised into its body was collected (Harrison 1986).

The Firehole phase is distinguished from the preceding Uinta phase by a dramatic decline in radiocarbon dates possibly related to a decline in population density. Site 48SW5176 (Hoefer et al. 1992) is a Brush shelter site, 15-30 loci with one burned structure, Cottonwood and Desert Side-notched points, large mammal bone fragments, Intermountain Ware ceramics, shell beads, and obsidian debitage (11% of total site) and tools sourced to Malad, ID.

Protohistoric Period

The Protohistoric period begins sometime after 300 years YBP with the first European trade goods to reach the area, and ends with the development of the Rocky Mountain fur trade 150 years ago. The Wyoming Basin was the heart of Shoshone territory during this period, with occasional forays into the area by other groups such as the Crow and Ute (Smith 1974). The most profound influence on native cultures during this time was the introduction of the horse enabling Native Americans to expand their range. All forms of rock art denoting horses, metal implements, and other Euro-American goods are associated with the Protohistoric period. Metal projectile points have been recovered from both surface and subsurface contexts in southwest Wyoming. The Upper Powder Springs Hunting Complex is a multi-component site located south of the project area (Murcray et al. 1993). Protohistoric artifacts recovered from the complex include tinklers and trade beads.

Historic Period

Historic use of the study area is associated with limited ranching/grazing activities. Filing for water rights occurred as early as 1906 on Black Buttes Creek north of the study area. Filing for water rights for mineral development, west of the study area, occurred as early as 1924. No buildings or corrals associated with ranching/shepherding activities are depicted on the 1884, 1908, 1912, or 1913 GLO maps of the study area. Local ranch roads, including the Road to Black Buttes and Rife's Bitter Creek Road, are shown on the 1908, 1912, and 1913 GLO maps. These are local roads connecting the ranching community located to the south of the project area with the Union Pacific Railroad, located to the north. Historic emigration routes across Wyoming, such as the Overland Trail and the Cherokee Trail skirt the project area to the north and to the south but are outside of the project area. Table 3-12 summarizes the historic chronology of the area.

3.11.2 Summary of Known Cultural Resources

The Cultural Records Office in Laramie provided information on the previous work conducted in the Copper Ridge analysis area and documented cultural resources. Records at Western Archaeological Services (WAS) were consulted for previous work in the project area. Consultation with the Archaeological Specialist of the Rock Springs Field Office of the BLM was conducted. There have been 134 projects conducted in the study area resulting in the recordation of 70 sites. Of these projects, there were 79 Class III block and linear surveys including seismograph or geophysical surveys, well surveys, road surveys, pipeline surveys, and compressor station surveys, 1 monitor, 1 test excavation project, 1 historic overview, and 52 Class II sampling surveys. Limited amounts of field work have resulted in the documentation of cultural resources through survey, testing, examination of ethnographic records, and historic record research. No excavations have been conducted in the Copper Ridge Environmental Assessment (EA) study area. No radiocarbon analysis has been conducted on cultural resources in the project area.

The CRPA encompasses approximately 38.9891 square miles or 24,953.01 acres. Federal surface acreage is 11,564.91 acres, 1280 acres of State of Wyoming land, and 12,108.12 acres are private land. Mineral ownership is 46% federal, 5% State of Wyoming, and private owners retain 49% ownership. Approximately 3619 acres (block) or ca. 14.5% of the project area have been inventoried for cultural resources. The site density calculated using the total project area and recorded sites in the project area is one site per 356 acres.

The overall site density within the study area varies with the highest number of sites located along drainages and near the major topographic land forms. Site density along the ridges in the

Table 3-12. Historic Chronology.

Phase	Age A.D.
Protohistoric	1720 - 1800
Early Historic	1800 - 1842
Pre-Territorial	1842 - 1868
Territorial	1868 - 1890
Expansion	1890 - 1920
Depression	1920 - 1939
Modern	1939 - Present

from Massey 1989

juniper trees is high. Many sites are located along Black Buttes Creek and Sand Wash and their ephemeral drainages. Some sites are situated around the natural springs in the study area and some sites are located on prominent points overlooking the drainages. The site density away from these areas is relatively low.

Site types

Seventy sites have been recorded in the project area including 60 prehistoric sites (51 prehistoric camps (1 with ceramics and 1 with milling and plant processing activities), 9 lithic scatters (1 secondary lithic procurement and 1 destroyed site), 7 historic sites (2 local roads, 3 sheep herding/ranching, and 2 debris scatters), and 3 prehistoric/historic sites. Of the total site types, 86% are prehistoric sites, 10% are historic sites, and 4% contain both prehistoric and historic components. Of the recorded cultural resources, 31.5% (n=22) are recommended eligible for nomination to the NRHP, 31.5% (n=22) are recommended not eligible for nomination to the NRHP, 36% (n=25) remain unevaluated to the National Register, and 1% (n=1) has been destroyed.

Prehistoric sites

Prehistoric camps consist of sites that contain evidence of a broad range of activities including subsistence-related activities. They may contain formal features, lithic debris, chipped stone tools, evidence of milling/vegetable processing activities including ground stone, and pottery. Single as well as multiple occupations are represented.

Lithic debris scatters consist of sites containing lithic debitage or stone tools. The sites are described as representing short-term activities. Counted in the lithic scatters is one site documented as a secondary lithic procurement site.

Quarries are sites where lithic raw material was obtained and initially processed. Primary and secondary lithic procurement areas are geologic locations where chert and quartzite cobbles have been redeposited. No quarry sites have yet to be documented in the study area.

Lithic landscapes are secondary lithic procurement deposits recommended not eligible for inclusion on the National Register. The artifacts from the sites cannot be associated with a specific cultural group or tradition nor can they be temporally associated. No lithic landscapes have been documented in the study area.

Human burials, rock alignments, stone circles, cairns, and rock art have been identified as sensitive or sacred to Native Americans. Although human burials or rock art have not been documented in the project area, it is important to be cognizant of the possibility of such resources in the project area. Several such sites have been documented in the areas surrounding the study area. No prehistoric cairns/caches are reported in the project area.

Pottery/ceramics are relatively rare and only one site containing pottery has been identified in the study area. Pottery is usually associated with the Uinta phase of the Late Prehistoric period. Many times only a few fragmentary shards are found on a site's surface.

Consultation with appropriate Native American tribes pertaining to areas of concern for traditional, cultural, and religious purposes will occur in accordance with the American Indian Religious Freedom Act and BLM Manual 8160-1 Handbook. Native American consultation will occur within the context of specific development proposals, but will also be an ongoing process between BLM and affected Indian tribes and traditional cultural leaders (USDI 1997).

Historic sites

The Road to Black Buttes is an expansion era road, which connected the rural population of Vermillion Creek/Coyote Creek area of southern Sweetwater County with the Union Pacific Railroad. Transportation of freight and trailing stock to the railroad were primary functions along the wagon road. The portion of the Road to Black Buttes contained within the study area is upgraded Sweetwater County Road 4-24/4-26. A historic overview of the Road to Black Buttes, Site 48SW12421, determined the road to be not eligible for inclusion on the National Register (Johnson 2001).

Rife's Road to Bitter Creek is an expansion era road located in the south and east portions of the study area recommended not eligible for inclusion on the National Register. Historically, the road was used to connect the Rife Ranch, the Guy Rife Ranch, and other ranches of southwest Wyoming with headquarters at Bitter Creek. The area in Sweetwater County was used as winter range for sheep ranchers. Supplies were taken to the camps and animals were trailed north to the railroad at the town of Bitter Creek. Portions of the road were improved in the early 1900s by Sweetwater County and later more of the road was improved by the companies for mineral development. However, much of the road remains a two-track (Ficenec 1998).

Ranching and stock herding activities are represented by herding camps (n=3) in the study area. Filing for water rights occurred as early as 1906 on Black Buttes Creek north of the study area. Filing for water rights for mineral development, west of the study area, occurred as early as 1924. Local ranch roads present on the GLO maps include the Rife's Road to Bitter Creek and the Road to Black Butte.

Summary

Prehistoric subsistence and settlement patterns of the region reflect a hunter-gatherer lifeway. Research into the subsistence and settlement patterns used during the Archaic period indicates summer occupations in the mountains, winter occupations in the foothills, and spring and fall movements utilizing all available zones (Creasman and Thompson, 1997). Subsistence patterns in the Archaic period and the Late Prehistoric period are similar in that they are based on seasonal movement throughout the basins and foothills in response to the availability of floral and faunal resources (Creasman and Thompson 1988). A wide diet breadth is evident in extensive procurement and processing of small mammals. By 450 YBP (Shimkin 1986), or possibly earlier (Bettinger and Baumhoff 1982), Numic-speaking Shoshonean groups occupied the Wyoming Basin and continued to reside there until Euro-American expansion relegated them to reservations beginning in 1868.

Important cultural resources are found along the major ephemeral drainages and ridge tops in the juniper trees. Sensitive areas include Black Buttes Creek and Sand Wash drainages. Certain topographic settings have higher archaeological sensitivity such as eolian deposits (sand dunes, sand shadows, and sand sheets), alluvial deposits along major drainages, and colluvial deposits along lower slopes of ridges.

Historic use of the project area was restricted by terrain and limited to grazing activities. Historic use of the area to the north and the south of the Copper Ridge EA study area includes westward migration routes including the Overland Trail, the Pine Butte Variant of the Overland Trail, and the north and south branches of the Cherokee Trail. No documented trails are located within the Copper Ridge study area.

3.12 SOCIOECONOMICS

3.12.1 Introduction

Area socioeconomic conditions potentially affected by the Proposed and No Action alternatives include the local economy (primarily employment and earnings in the oil and gas industry and other sectors of the economy), population, housing, emergency response services, and local, state and federal tax revenues.

The area of analysis for potential socioeconomic impacts is Sweetwater County, Wyoming.

3.12.2 Economic Conditions

An area's economic base is comprised of activities, which bring money into the local economy from other areas of the state, nation and world. Sweetwater County has a diversified natural resource-based economy. Basic sectors include oil and gas production and processing, coal mining, electric power generation, trona mining and the manufacturing of soda ash and related products, fertilizer manufacturing, agriculture, and transportation (primarily the Union Pacific railroad). Also, the portions of the retail and service sectors which serve visitors (travel, tourism and recreation) can be considered basic (PIC 1996).

3.12.2.1 Employment, Unemployment and Labor Force

Sweetwater County total full and part-time employment grew from the 1990 level of 22,856 jobs to a 2000 level of 24,436, growing by about seven percent or 1,580 jobs. There was some volatility during the period, however. In 1994, total employment peaked at 25,177jobs (WDAI 2002a). These employment statistics, compiled by the US Bureau of Economic Analysis, represent full and part-time jobs located in the county. Some Sweetwater County jobs are filled by persons living outside the county.

Local area labor force, employment and unemployment statistics are compiled by the Wyoming Department of Employment and represent county residents who are employed or unemployed. According to these statistics, Sweetwater County resident employment was about one percent higher in 2001 (19,447) than in 1990 (19,231). As with the number of jobs discussed above, resident employment was somewhat higher during the 1994-1995 period. The local labor force (employed residents plus residents looking for work) began and ended the period at about the same level (20,348 and 20,388, respectively). Resident employment increased slightly and the local labor force was virtually flat over the last decade, but the unemployment rate decreased from 5.5 percent in 1990 to 4.6 percent in 2001 (WDE 2003). This decrease in the unemployment rate reflects a smaller number of county residents registered as unemployed in the Department of Employment system. In all likelihood, a portion of unemployed residents left Sweetwater County to seek work elsewhere during this period.

Recently, employment conditions in Sweetwater County have been changing. Oil and gas service firms are adding employees, both from the local labor pool and from outside of the county. At the same time, the trona/soda ash industry is undergoing a reduction in workforce (Robbins 2003).

3.12.2.2 Earnings

Sweetwater County earnings by place of work increased from $633 million in 1990 to $881 million in 2002, a 39 percent increase over the decade (WDAI 2002b). This increase compares to a 56 percent increase in earnings for the State of Wyoming during this period. However, when adjusted for inflation, Sweetwater County earnings increased by about 6 percent during this period.

3.12.2.3 Recent Oil and Gas Activity

Production and approved applications for well drilling permits (APDs) are two measures of oil and gas activity. As shown in Figure 3-14, annual natural gas production in Sweetwater County decreased from 238 million MCF in 1995 to 225 million MCF in 2001. Sweetwater County production accounted for about 14 percent of all natural gas produced in Wyoming during 2001 (WOGCC 1995-2001). Approved APDs reflect both current and potential future oil and gas activity. Increased drilling may result in increased production if drilling efforts are successful and commodity prices increase or stabilize at economic levels. Sweetwater County approved APDs have increased dramatically in recent years (see Figure 3-15 below), 534 APDs were approved in the county during 2001.

In 1995, there were a total of 1,544 producing wells (oil and gas) in Sweetwater County. By 2001, that number had increased to 2,377 a 54 percent increase over the 6 year period (see Figure 3-16). The relatively high levels of natural gas exploration, drilling and production that have occurred in Sweetwater County in recent years have sustained an active natural gas service industry (Robbins 2003). Additionally, natural gas development in the county is served by contractors operating out of Casper, Rawlins, Kemmerer, Evanston and Craig.

3.12.2.4 Other Economic Activities near the Project Area

In addition to oil and gas exploration and production, other economic activities occurring in and near the CRPA include grazing and low-intensity dispersed recreation, (Deakins 2003).

3.12.3 Population Conditions

Population levels in Sweetwater County have been volatile over the past 20 years. Sweetwater County population in 2000 was almost 10 percent lower than its 1980 level of 41,723 (see Figure 3-17). It is estimated that Sweetwater County population continued to fall in 2001, losing an additional 2 percent of population (WDAI 2002c).

Rock Springs, the largest community in the county, lost almost 2 percent of total population between 1990 and 2000, despite showing a 3 percent increase in 1995 (see Table 3-13). Similarly, Green River, the county's second largest city and county seat lost 7 percent of its population between 1990 and 2000, despite a slight increase in the early years of the decade.

Table 3-13. Population Estimates 1990 - 2000: Sweetwater County, Rock Springs and Green River

	1990	1995	2000
Sweetwater County	38,823	40,635	37,613
Rock Springs	19,050	19,687	18,708
Green River	12,711	12,778	11,808

Source: WDAI 2002

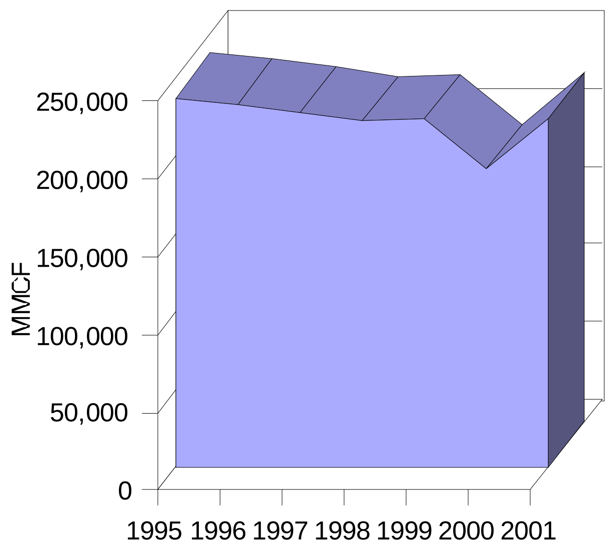
The most recent population forecasts available from the Wyoming Division of Economic analysis projects that population levels in Sweetwater County will decrease 6 percent by 2010, to 35,399 (WDAI 2002d).

3.12.4 Housing

The nature of natural gas drilling and field development activities (relatively short duration tasks performed primarily by contractors) results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces near the project area. However, as Sweetwater County oil and gas service firms respond to increased natural gas development in the county, it is likely that drilling and field development employees hired from outside the county will seek longer-term housing accommodation. Oil and gas production employees are typically interested in longer-term housing resources.

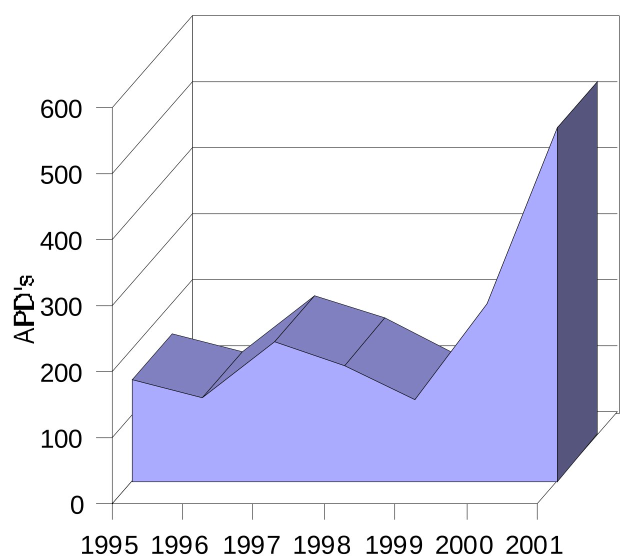
There are a substantial number of temporary housing resources (motels and RV parks) available in Rock Springs including 15 motels with over 1,100 rooms and 30 mobile home parks

Figure 3-14. Natural Gas Production for Sweetwater County 1995 - 2001



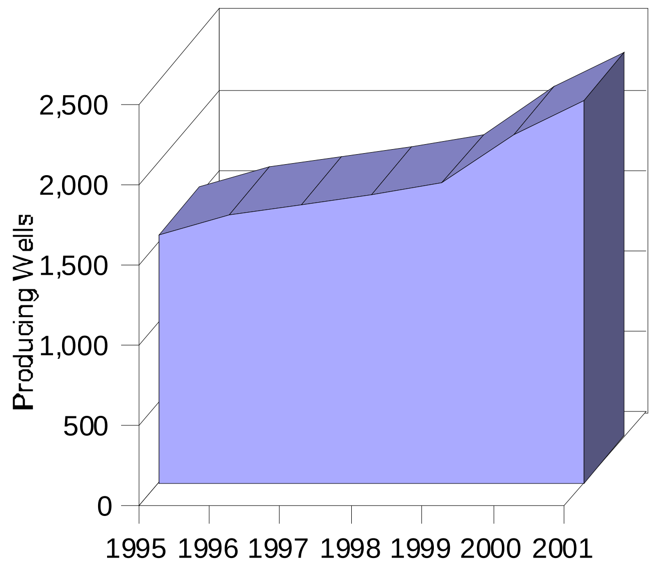
Source: WOGCC 1995-2001

Figure 3-15. Approved Sweetwater County Applications for Permits to Drill (APDs): 1995- 2001.



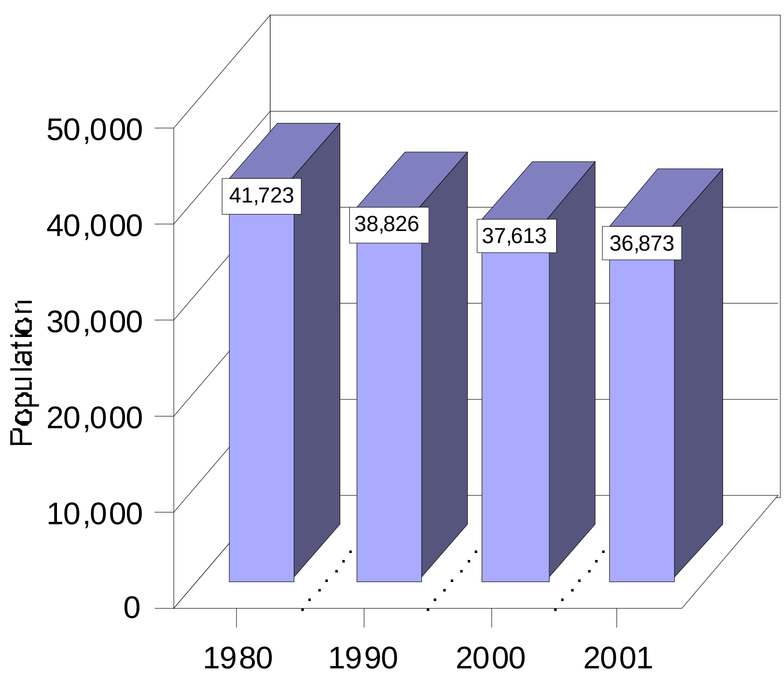
Source: WOGCC 1995-2001

Figure 3-16. Producing Oil and Gas Wells in Sweetwater County 1995 - 2001



Source: WOGCC

Figure 3-17. Sweetwater County Population: 1980, 1990, 2000 and 2001.



Source: WDAI 2002c

with over 1,900 pads (PIC 1997). Recently, the number of houses for sale has decreased as a result of lower interest rates, and housing and apartments are filling up as a result of the increased natural gas development activity in the county (Robbins 2003).

3.12.5 Community Facilities, Law Enforcement and Emergency Management Services

Because population in Sweetwater County, Rock Springs and Green River is substantially below historic high levels of the 1980's, county and municipal infrastructure has, in general, capacity to serve a larger population than currently exists. In fact, Sweetwater School Districts #1 (Rock Springs) and #2 (Green River) have closed several elementary schools because of declining enrollment, which is partly a function of declining population and partly a function of an aging population. One facility that is currently inadequate is the county jail, and the county is in the process of replacing that facility (Robbins 2003).

Law enforcement in the area surrounding the CRPA is provided by the Sweetwater County Sheriff's Department. No routine patrols are provided in the area, rather deputies respond on an as needed basis (Scofield 2003).

Emergency management in Sweetwater County is coordinated by the Sweetwater County Emergency Management Agency (SCEMA), which operates under Federal Emergency Management Agency (FEMA) and Environmental Protection Agency (EPA) guidelines. SCEMA is the agency designated by the Sweetwater County Commissioners to analyze potential hazards, assess emergency response capabilities, plan for and respond to potential events and mitigate the effects of emergencies or disasters. SCEMA coordinates with response agencies, industry, elected officials and volunteer agencies to accomplish its mission of limiting injuries, loss of life and damage to property.

The portion of Sweetwater County that includes the CRPA is served by emergency response organizations (fire suppression, emergency medical and ambulance) located in Rock Springs. Routine injuries are treated at Memorial Hospital of Sweetwater County. Cases requiring specialized treatment are transported to Salt Lake City by air ambulance services dispatched from Salt Lake City or Craig or Grand Junction in Colorado (Valentine 2003).

3.12.6 Local, State and Federal Government Fiscal Conditions

Fiscal conditions most likely to be affected by the Proposed Action and alternatives include the following:

- county, school and special district ad valorem property tax revenues,
- state, county and municipal sales and use tax revenues,
- state severance tax revenues,
- federal mineral royalties.

3.12.6.1 Ad Valorem Property Tax Revenues

Oil and gas companies pay ad valorem property taxes on production and facilities, with certain exemptions. In Sweetwater County, fiscal year (FY) 2002 assessed valuation was over $1.4

billion, 0.2 percent less than the previous year. 2002 property tax revenues were $93.2 million, about 0.7 percent lower than 2001. Natural gas is assessed on the previous year's production. FY 2002 assessed valuation from 2001 natural gas production totaled $577.6 million or about 41 percent of total assessed valuation (WTPA 2002). Current mill levies within the unincorporated portion of Sweetwater County which contains the CRPA total 70.235 mills, including 49.2 mills for schools, a 12 mill county levy, .266 for weed and pest control, a 5 mill community college levy, 2.195 mills for county fire protection and 1.574 mills for Solid Waste District #1.

3.12.6.2 Sales and Use Tax

Wyoming has a statewide four percent sales and use tax. Sweetwater County collects an additional one percent general-purpose local-option sales and use tax and a 0.5 percent specific purpose local-option tax, dedicated to construction of a new county jail. FY 2002 sales and use tax collections in Sweetwater County totaled about $59.56 million.

About 28 percent (less administrative costs) of the statewide four percent sales and use tax collections and all of the general purpose local option collections (also less administrative costs) are distributed to the county and its incorporated municipalities according to a population-based formula.

3.12.6.3 Wyoming Severance Taxes

The State of Wyoming collects a six percent severance tax on oil and natural gas. Severance tax revenues are distributed to the Wyoming Mineral Trust Fund, General Fund, Water Development Fund, Highway Fund, Budget Reserve Account, and to counties and incorporated cities and towns. In FY 2002, severance tax distributions totaled $299 million (CREG 2002a). Of the total, about 43 percent was attributable to severance taxes on natural gas.

3.12.6.4 Federal Mineral Royalties

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. Fifty percent of those royalties are returned to the state where the production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the University, the School Foundation fund, the Highway fund, the Legislative Royalty Impact Account, and cities, towns and counties. In FY 2002, a total of $348.6 million in federal mineral royalty funds were distributed to Wyoming entities (CREG 2002b).

3.12.7 Environmental Justice

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the *Federal Register* (59 FR 7629) on February 11, 1994. EO 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (defined as those living below the poverty level). There are no persons living within or immediately adjacent to the

CRPA.

3.13 TRANSPORTATION

The regional transportation system serving the CRPA includes an established system of interstate and state highways and county roads. Local traffic on federal land is also served by improved and unimproved BLM and oil and gas field roads.

3.13.1 Access to the Project Site

Access to the project site is provided by I-80, Wyoming State Highway 430 (WYO 430), and Sweetwater County roads 4-26 (Brady Field Road), 4-24 (Patrick Draw Road) and 4-19 (Bitter Creek Road) as shown on Figure 3-18. Table 3-14 displays traffic data, where available, for the highway access routes to the project area.

Federal and State Highways - Current traffic volumes on Wyoming federal and state highways are listed in Table 3-14. The Wyoming Department of Transportation (WYDOT) assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. A represents the best travel conditions and F represents the worst. The federal and state highways proving access to the CRPA are currently rated A, and traffic on these highways could increase substantially before level of service standards would be exceeded.

WYO 430 is a two lane-paved highway with narrow shoulders and steep side slopes. Although the highway is in relatively good condition, it is an older highway and the design is not up to current standards. For example, some bridges are narrower than current standards.

There is also concern that the approach to WYO 430 from SCR 4-26 may not be large enough to handle tractor-trailer combinations. This results in safety concerns as trucks must use two-lanes for turning when entering the highway. Additionally, because the approach from SCR 4-26 to WYO 430 is gravel, vehicles can deposit mud and gravel on the highway, resulting in maintenance problems and safety hazards (Montuoro 2003).

Sweetwater County Roads - The Sweetwater County Road and Bridge Department is responsible for maintaining over 1,400 mile of county roads. The three Sweetwater County roads that provide access to the CRPA (SCR 4-26, SCR 4-24 and SCR 4-19) are two-lane roads constructed of native material and graveled when the Road and Bridge Department can budget for and obtain gravel. SCR 4-26 (Brady Field Road) travels about 12 miles east-northeast and then southeastward from its intersection with WYO 430 to its intersection with SCR 4-26 within the CRPA. SCR 4-24 (Patrick Draw Road) travels about 20 miles southward from its intersection with I-80 to its intersection with SCR 4-26 within the CRPA. It proceeds

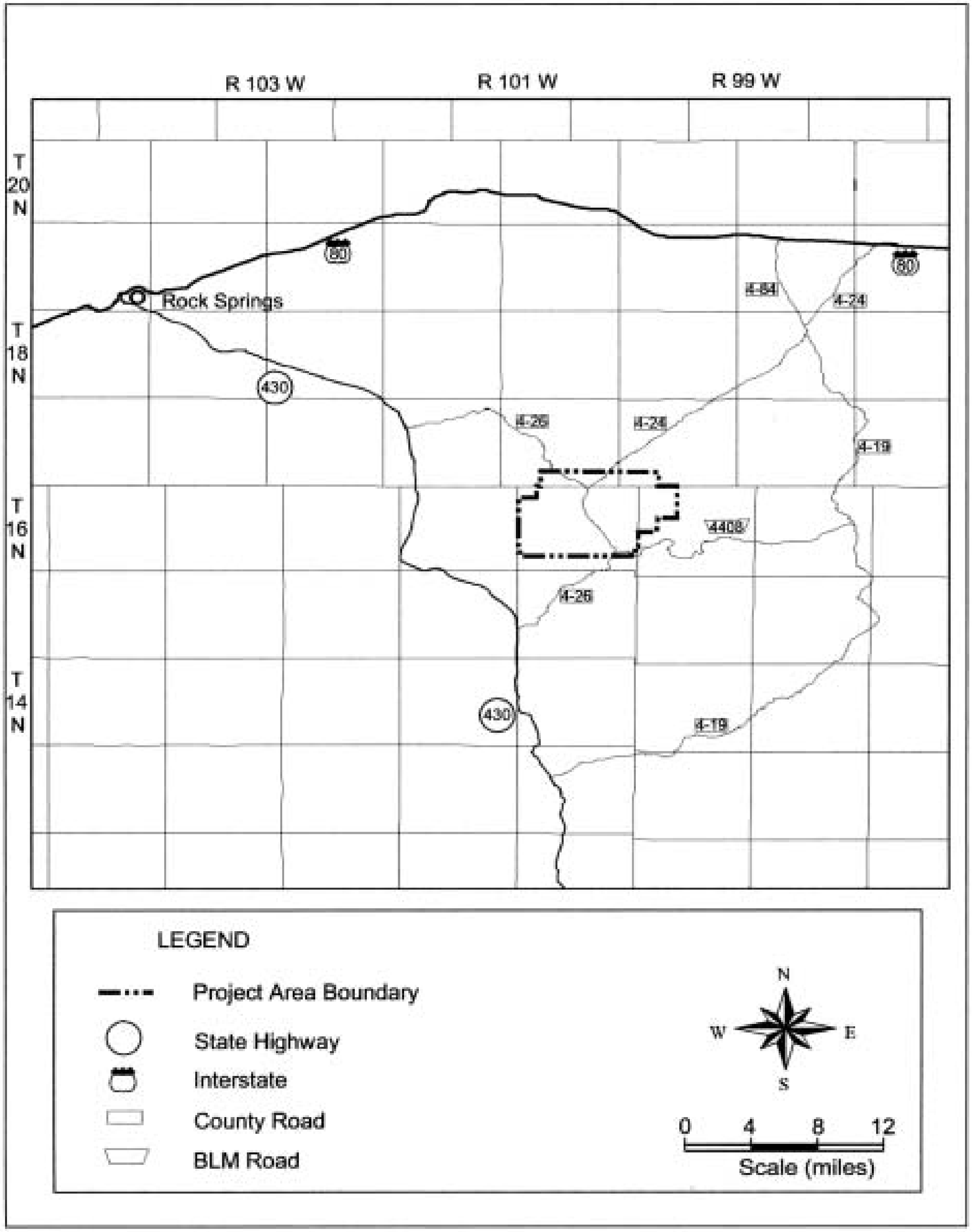


Figure 3-18. Copper Ridge Project Area Access

Table 3-14. Highway Access to the Project Site.

Route	2001 AADT	2000 AADT	Level of Service
I-80 @ Patrick Draw Intersection	11,500 (5,870 trucks)	10,900 (6,400 trucks)	A
I-80 @ Bitter Creek Intersection	11,510 (5,870 trucks)	10,900 (6,300 trucks)	A
WYO 430 @ SCR 26 Intersection	170 (40 trucks)	250 (40 trucks)	A

Source: WYDOT 2001

south for another 5 miles before exiting the CRPA. Approximately 5 miles after exiting the CRPA, SCR 4-24 intersects with WYO 430. SCR 4-19 (Bitter Creek Road) travels about 6 miles south to its intersection with SCR 4-24 and proceeds southward. Travelers approaching from the west would likely exit I-80 onto SCR 19 as a shortcut to SCR 4-24.

These roads serve primarily oil and gas field traffic, and also provide access for grazing operators and recreation users. Some oil and gas operators in the area occasionally contribute gravel and water to the Road and Bridge Department for application on these roads. Maintenance of these roads is a high priority for the county; consequently, two motor graders are stationed in the area. Although the county would prefer to gravel these roads annually, budget limitations and the lack of a gravel source within the area limit the amount of gravel that is applied.

Speeding is a problem in and near the CRPA. In addition to the obvious safety hazards, speeding vehicles accelerate maintenance requirements and remove gravel from the roadbed (Gibbons 2003). Dust is also a problem on these roads.

3.13.2 Access within the Project Area

Existing access within the proposed CRPA is provided by SCR 4-24 and SCR 4-26 (discussed above) and an existing road network developed to service prior and ongoing drilling and production activities in the Brady and Jackknife Spring fields, and ongoing livestock grazing activities in the Rock Springs Grazing Allotment. Additionally, about one mile of BLM road 4408 is located in the southwest corner of the CRPA. BLM Road 4408 provides access eastward from SCR 24 to Pine Butte Basin (Figure 3-15).

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the CRPA include hazards associated with existing oil and gas exploration and operations. Occupational hazards associated with oil and gas operations generally affect workers in the fields and at oil and gas facilities. Two types of workers are employed in oil and gas fields: oil and gas workers, who had a1998 annual accident rate of 4.0 per 100 workers, and special trade contractors, who had a non-fatal accident rate of 8.9 per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 2000). These rates compare with an overall private industry average for all occupations of 6.2 per 100 workers.

There are also existing risks associated with natural gas pipelines, although these risks are statistically very small. Nationwide, injuries associated with gas transmission pipelines averaged 14 per year from 1990 through 1996, fatalities averaged one per year and incidents such as ruptures averaged 79 per year (U.S. Department of Transportation 1998). Finally, there are risks associated with hazardous materials used or stored at oil and gas facilities. The US BLM, OSHA, USDOT and Wyoming OGCC and OHSA each regulate certain safety aspects of oil and gas operations.

Currently within the CRPA there are risks associated with vehicular travel on improved and unimproved county, BLM and oil and gas field roads; with firearms accidents during hunting season and by casual firearms use such as plinking and target shooting; and with natural events such as flash floods, landslides, earthquakes and range fires, which can also result from human activities.

3.15 NOISE

On-going drilling and production operations and related traffic create most sound disturbances within and in the immediate vicinity of the CRPA. Aircraft overflights (generally at high altitudes) and localized vehicular traffic on county, BLM and two-track roads in the project area also create short-term, localized sound disturbances.

CHAPTER 4

ANALYSIS OF ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

This chapter of the environmental assessment (EA) provides an analysis of the potential environmental consequences that would result from implementation of the proposed Copper Ridge Shallow Gas project. Certain measures that would avoid or reduce impacts under the Proposed Action have been included in Chapter 2. The following impact assessment takes these measures into consideration. Additional opportunities to mitigate impacts beyond the measures proposed in Chapter 2 are presented in this chapter for each resource discipline.

An environmental impact or consequence is defined as a modification or change in the existing environment brought about by the proposed action or alternatives to the proposed action. Impacts can be direct or indirect in nature, and can be permanent (long-term) or temporary (short-term). Impacts can vary in degree ranging from only a slight discernable change to a drastic change in the environment. Short-term impacts are impacts that occur during and immediately after construction and testing and last from two to five years. For purposes of this EA, short-term impacts are defined as lasting five years or less. Long-term impacts are impacts imposed by construction and operations that remain longer than five years and extend for the life of the project and beyond.

The description of the environmental consequences for each resource section in this chapter includes the following subsections:

Impacts The level and duration of impacts that would occur as a result of the Proposed Action or the No Action Alternative. The impact evaluation assumes that the applicant-committed practices described in Chapter 2 would be implemented. Direct impacts are those which are caused by the action and occur at the same time and place. Indirect impacts are those impacts which are caused by the action but occur later in time or farther removed in distance.

Mitigation - A summary of additional measures that could be applied to avoid or reduce impacts. Mitigation items specified in the Mitigation Summary are *assumed to be* applicable to impacts on all lands, regardless of ownership. However, it would be up to Anadarko to determine which measures would be applied, to what degree, and where on their privately-owned lands. Anadarko would coordinate with the State of Wyoming as to application of mitigation on state-owned lands. The measures identified under this section would be considered for application on public lands administered by the BLM. If no additional mitigation is proposed, the mitigation and residual impact sections will not be discussed.

Residual Impacts - A summary of impacts that are unavoidable and cannot be reduced or eliminated through the application of available and reasonable mitigation and, therefore, would remain throughout the duration of the project and to some point beyond.

Cumulative Impacts - A description of impacts likely to occur due to this project in combination with other on-going and recently approved activities, recently constructed projects and other past projects, and projects likely to be implemented in the near future (reasonably foreseeable developments or RFDs). Cumulative impacts associated with the Proposed Action and alternatives are summarized in Chapter 5 of this EA.

Unavoidable adverse impacts, short-term use of the environment versus long-term productivity, and irreversible and irretrievable commitment of resources are discussed in separate sections following the discussions of the specific resources (Sections 4.16, 4.17, and 4.18 respectively). Unavoidable adverse impacts cannot be avoided and cannot be completely mitigated. Short-term use of the environment covers the life-of-project (LOP), whereas long-term productivity refers to the period after the project is completed and the area reclaimed. Irreversible and irretrievable impacts are permanent reductions or losses of resources that, once lost, cannot be regained.

4.1 GEOLOGY/MINERALS/PALEONTOLOGY

4.1.1 Geology

4.1.1.1 Impacts

4.1.1.1.1 Proposed Action

Impacts could occur to the geologic environment as a result of Proposed Action if alteration of existing land surface steepens slopes or otherwise increases runoff or causes undercutting that could initiate slumping, landslides or other mass movements. This is particularly true in the eastern part of the area along Six Mile Rim, where relief is greatest. If existing BLM construction restrictions on slopes and construction design described in Chapter 2 are followed the possibility of the project initiating landslides or other mass movements, flooding is considered unlikely.

Impacts could occur to the geologic environment as well as project facilities as a result of inherent geologic hazards (e.g., landslides, mass movements, earthquakes), but this is considered unlikely. The low eastward dips on the rocks at the surface and relatively low relief, except in the eastern part of the area along Six Mile Rim, lessens the chance for naturally occurring mass movements. In addition, no landslides or mass movement deposits occur within the project and no earthquake epicenters have been documented within 10 miles of the project area.

4.1.1.1.2 No Action Alternative

Under this alternative, additional gas development could occur through the approval of individual wells on Federal lands. Development on State and private lands would continue though Wyoming Oil and Gas Conservation Commission approval. Impacts to the geological environment would be similar to those described under the Proposed Action, but to a lesser extent.

4.1.1.2 Mitigation

No additional mitigation to the geologic environment is required.

4.1.1.3 Residual Impacts

No residual impacts to the geologic environment are identified.

4.1.2 Minerals

4.1.2.1 Impacts

4.1.2.1.1 Proposed Action

Natural gas is the only mineral resources that would be impacted with implementation of the Proposed Action. Production of natural gas would deplete reserves, but the proposed project allows for recovery of Federal natural gas resources per 43CFR 3162(a) and generation of private and public revenues.

4.1.2.1.2 No Action Alternative

Under this alternative, additional gas development could occur through the approval of individual wells on Federal lands. Development on State and private lands would continue though Wyoming Oil and Gas Conservation Commission approval. Impacts to the mineral resources would be similar to those described under the Proposed Action, but to a lesser extent. Additionally, loss of federal energy resources, and therefore royalties, could occur due to drainage for wells located on private lands.

4.1.2.2 Mitigation

No mitigation to the mineral environment is required.

4.1.2.3 Residual Impacts

Depletion of natural gas reserves is an unavoidable impact associated with implementation of the Proposed Action. Drilling of wells however, may result in the identification of additional as yet unknown gas reserves, and allow the orderly development of gas reserves in the Copper Ridge Unit.

4.1.3 Paleontology

4.1.3.1 Impacts

4.1.3.1.1 Proposed Action

Impacts could occur to paleontology resources if surface disturbance associated with the Proposed Action results in exposure and destruction of important fossil resources, along with associated loss of geologic information. Mitigation measures under the Proposed Action could result in new and scientifically important fossil resources being discovered and properly recovered and cataloged into the collection of a museum repository, so that they are available for study.

Early Tertiary (Eocene) aged sedimentary deposits represented by the Green River Formation, Wasatch Formation, and Fort Union Formation underlie the project area. All of these formations either have produced or have the potential to produce vertebrate fossils of scientific significance either in the area itself or surrounding area. The potential for discovery is greatest where the formations crop out at the surface as depicted in Figure (soils figure), where surface weathering has concentrated fossil remains. However, the potential for the discovery extends throughout the formations, either in the subsurface or surface.

4.1.3.1.2 No Action Alternative

Under this alternative, additional gas development could occur through the approval of individual wells on Federal lands. Development on State and private lands would continue though Wyoming Oil and Gas Conservation Commission approval. Impacts to the paleontological resources would be similar to those described under the Proposed Action, but to a lesser extent.

4.1.3.2 Mitigation

No additional mitigation would be required.

4.1.3.3 Residual Impact

It is anticipated that some fossils will be destroyed during construction activities because they were not seen or reported, however implementation of the recommended mitigation measures will reduce the magnitude of impact to the extent possible.

4.2 AIR QUALITY

4.2.1 Impacts

4.2.1.1 Proposed Action

4.2.1.1.1 Summary

Proposed Action emission sources would include those resulting from well development, well production, and gas compression and processing. This includes increased vehicle traffic and drilling activity during the construction phase of the Proposed Action, followed by continuous well pump and natural gas compression emissions. Air pollutant emissions from these sources would include oxides of nitrogen (NO_X), carbon monoxide (CO), particulate matter less than 10 and 2.5 microns in effective diameter (PM_{10}, $PM_{2.5}$) and volatile organic compounds (VOCs). Results indicate that formaldehyde would be the only hazardous air pollutant (HAP) emitted from the Proposed Action sources. Emissions of benzene, toluene, ethylbenzene and xylenes (BTEX) compounds would be inconsequential due to the composition of the produced gas.

Total estimated emissions for the Proposed Action are summarized in Table 4-1. All development related emission calculations which include well pad and resource road construction, well drilling, and well completion, assume maximum development at the rate of 45 wells per year over a two-year period.

The individual sources of Proposed Action related emissions are discussed below. Detailed emission calculations for each activity are available in the BLM's RSFO project file.

Table 4-1. Proposed Action Emission Summary

Pollutant	Emissions (tons/year) Well Development	Well Production	Well Subtotal	Gas Compression and Processing	Total Estimated Emissions (tons/year)
NO_X	52.7	51.6	104.3	174.7	279.0
CO	14.7	51.6	66.3	116.5	182.8
VOC	4.7	16.1	20.8	58.2	79.0
SO_2	0.9	0.0	0.9	0.0	0.9
PM_{10}	64.6	9.7	74.3	0.0	74.3
$PM_{2.5}$	13.1	3.9	17.0	0.0	17.0
Benzene	0.0	0.0	0.0	0.0	0.0
Toluene	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.0	0.0	0.0	0.0	0.0
Xylene	0.0	0.0	0.0	0.0	0.0
n-Hexane	0.0	0.0	0.0	0.0	0.0
Formaldehyde	0.1	2.6	2.6	8.2	10.8

Construction, Drilling, and Well Development Emissions

During the construction phase, vehicle and fugitive dust emissions would increase within the Proposed Action area. Vehicle emissions would result from work crews commuting to and from the work site and from the transportation and operation of construction equipment. Vehicle tailpipes would emit small quantities of NO_X and CO. Fugitive dust concentrations would increase with additional vehicle traffic on unpaved roads and from wind erosion in areas of soil disturbance. Drill rig operations would result mainly in an increase of NO_X and CO emissions. Emission rates were calculated using applicable EPA emission factors and anticipated level of operational activities, such as estimated vehicle trips, load factors, and hours of operation.

Development emissions would be in addition to the vehicle emissions generated from existing operations within the Proposed Action area. However, because of the limited scope (restricted to locations where construction is actively taking place) and the short-term nature of these emissions (two year development period), the aggregate impact of vehicle tailpipe, fugitive dust, and drill rig emissions would be minimal over the life of the Proposed Action. Based on the analysis of results from larger actions such as the Draft Environmental Impact Statement/Draft Planning Amendment for the Powder River Basin Oil and Gas Project and the Desolation Flats Natural Gas Field Development Project Environmental Impact Statement (Bureau of Land Management 2003; Bureau of Land Management 2002), well development sources are not predicted to have substantial effects on air quality within the Proposed Action area or the surrounding cumulative assessment area.

Compressor Engines and Well Pumps

Two natural gas compressor stations, each consisting of five 1206 hp compressors and one dehydrator would be constructed and operated. For analysis purposes, it was assumed that

Caterpillar 3516 TALE compressor engines would be utilized. The compressors represent the primary Proposed Action source of NO_X and CO emissions at 174.7 and 116.5 tons per year, respectively. The dehydrator burner emissions are assumed to be inconsequential at less than one ton per year of NO_X and CO. The compressors and dehydrators would also emit lesser amounts of VOCs.

According to the project proponent, each well would require a pump rated at up to 30 hp, for a total power requirement of 2670 hp. The well pumps may be directly driven by natural gas-fueled engines or consist of electric pumps powered by natural gas-fueled generators. At emission rates of 2 grams per horsepower-hour, well pumps are estimated to account for 51.6 tons per year of both NO_X and CO emissions.

4.2.1.1.2 Criteria Pollutant Impacts

The latest version of the AERMOD-PRIME dispersion model was applied to predict maximum criteria pollutant and formaldehyde air quality impacts. Proposed Action sources included in the modeling analysis were compressor engines and well pumps. Five years of Rock Springs surface and corresponding Lander upper air meteorological data (1985, 1987-1990) were utilized in the modeling analysis. Adjustments to annual predicted NO_x concentrations were made in accordance with the Ambient Ratio Method (ARM) as specified in EPA's Guideline on Air Quality Models (EPA 2003). The ARM accounts for the atmospheric conversion of nitric oxide (NO) to nitrogen dioxide (NO_2).

The Proposed Action sources were evaluated against significance criteria for NO_x and CO emissions. Tables 4-2 and 4-3 compare the maximum predicted air quality impacts with the appropriate National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) Class II increments. Since there are no PSD increments for CO, only the NO_2 increment is presented in Table 4-3. As shown, the predicted impacts are substantially less than the applicable NAAQS and PSD Class II increments.

Table 4-2. Proposed Action Impact Comparison to NAAQS

Pollutant and Averaging Time	Maximum Proposed Action Impact (:g/m^3)	Background Concentration (:g/m^3)	Maximum Proposed Action Impact Plus Background (:g/m^3)	National and Wyoming Ambient Air Quality Standard (:g/m^3)	Percent of NAAQS
NO_2 Annual	12.6	3.4[a]	16.0	100	16.0%
CO 1-hour	95.1	2,299[b]	2394.1	40,000	6.0%
CO 8-hour	82.0	1,148[b]	1230.0	10,000	12.3%

[a] Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period June 10, 1998 – December 31, 2001 (ARS 2002)
[b] Data collected at Rifle and Mack, Colorado in conjunction with proposed oil shale development during the early 1980's (CDPHE-APCD 1996)

Table 4-3. Proposed Action Impact Comparison to PSD Increments

Pollutant and Averaging Time	Maximum Proposed Action Impact (µg/m^3)	PSD Class II Increment (µg/m^3)	Percent of Increment
NO_2 Annual	12.6	25	50.4%

4.2.1.1.3 Hazardous Pollutant Impacts

Hazardous Air Pollutant (HAP) emissions were evaluated for both long-term (chronic) health effects and carcinogenic effects. Test results indicate the absence of typical HAP constituents in the gas stream that would be processed through the dehydrators. However, low levels of formaldehyde (CH_2O) would be emitted from the compressor engines and well pump sources.

To assess the potential health effects of formaldehyde exposure, predicted concentrations were compared to reference concentrations (RfCs) for chronic exposure (EPA 2002). The RfCs represent an estimate of the continuous inhalation exposure rate to the human population (including sensitive subgroups such as children and the elderly) without an appreciable risk of harmful effects during a lifetime.

For the Proposed Action, the maximum predicted formaldehyde concentration represents a small percentage of the RfC, as illustrated in Table 4-4 below, indicating that no chronic adverse health effects would be expected.

Table 4-4. Formaldehyde Reference Concentration Comparison

Hazardous Air Pollutant	Reference Concentration (RfC) (µg/m^3)	Maximum Predicted Concentration (µg/m^3)	Percentage of RfC
Formaldehyde	9.8	0.8	8.2 %

The EPA has classified formaldehyde as a probable human carcinogen of medium carcinogenic hazard with an inhalation unit risk factor of 1.3×10^{-5} $(\mu g/m^3)^{-1}$ (inverse micrograms per cubic meter) (EPA 1994).

Predicted formaldehyde concentrations were combined with traditional risk assessment methods to estimate the potential cancer risk from formaldehyde exposure (Table 4-5). Utilizing the predicted maximum formaldehyde concentration of 0.80 µg/m^3 and assuming a maximum exposure scenario of 24 hours per day for the expected life of the project (20 years), the incremental formaldehyde cancer risk is estimated at 2.9 per one million exposures. This estimated formaldehyde risk is slightly higher than the EPA significance criteria of 1.0 per million exposures. This method of analysis, however, is extremely conservative based on the assumption that persons would be exposed to the maximum model predicted concentration of formaldehyde for 24 hours per day over a 20 year period. Furthermore, the maximum predicted concentrations of formaldehyde were observed at locations very close to the proposed compressor stations and decreased rapidly with distance, indicating that an occupational exposure scenario would be most appropriate.

Using a more realistic occupational exposure scenario of eight hours exposure per day for the life of the Proposed Action, termed the most likely exposure or MLE, the incremental risk is estimated at 0.9 per million exposures, just under the EPA significance criteria of 1.0 per million exposures.

4.2.1.1.4 Air Quality Related Value Impacts

The latest version of the CALPUFF dispersion model was used, in the screening mode, to estimate the Proposed Action impacts on Air Quality Related Values (AQRVs) for selected areas of special concern. Five years of Rock Springs surface meteorological data (1985, 1987-1990) were applied in the analysis. Proposed Action sources included compressors, well pumps, wind erosion, drill rig, and vehicle dust and tailpipe emissions. Predicted results were evaluated against visibility, dry and wet deposition, and acid neutralization capacity (ANC) criteria for the areas of special concern listed in Table 4-6.

Table 4-5. Potential Incremental Carcinogenic Risk

Hazardous Air Pollutant	Incremental Carcinogenic Risk Resulting from the Maximum Exposure Scenario[1]	Incremental Carcinogenic Risk Resulting from the Most Likely Exposure Scenario[2]
Formaldehyde	2.9 in one million	0.9 in one million

Risk/Million:

$$= \frac{(CH_2O\ \mu g/m^3)*(\text{Expected Life of Proposed Action}/70\text{ Year Life Span})*(CH_2O\text{ Unit Risk Factor})}{1.0E\text{-}6}$$

$$= {}^{1}\ \frac{(0.8\ \mu g/m^3)*(0.286)*(1.3E\text{-}5)}{1.0E\text{-}6} = 2.8/\text{million}$$

$$= {}^{2}\ \frac{(0.8\ \mu g/m^3)*(0.286)*(8/24)*(1.3E\text{-}5)}{1.0E\text{-}6} = 0.9/\text{million}$$

Table 4-6. Areas of Special Concern

Special Concern Area	Managing Agency	Distance from Proposed Action (mi)	Direction from Proposed Action
Bridger Wilderness	USFS	93	NNW
Fitzpatrick Wilderness	USFS	140	NNW
Popo Agie Wilderness	USFS	93	NNW
Savage Run Wilderness	USFS	140	ESE
Wind River Roadless	USFS	120	NNW

Visibility Impacts

Visibility impairment was evaluated in terms of the change in deciview (Δ dv). The deciview index was developed as a linear perceived visual change. A change in visibility of 1.0 dv represents a "just noticeable change" by the average person under most circumstances. Increasing deciview values represent proportionately larger perceived visibility impairments. The Forest Service uses a 0.5 Δ dv as a level of acceptable change (LAC) threshold in order to protect visibility in sensitive areas. A 1.0 Δ dv threshold is used in the Regional Haze Regulations and has been used by other agencies as a management threshold. The 0.5 and 1.0 Δ dv thresholds are neither standards nor regulatory limits. Rather, they are used to alert the affected land managers that potential adverse visibility impacts may exist and the land manager may wish to look at the magnitude, duration, frequency, and source of the impacts in more detail in order to make a significance determination.

For the Proposed Action, a screening level analysis for visibility was conducted following the recommendations in the FLAG (2000) Guideline document. The potential sources of visibility impairment resulting from the Proposed Action are primary PM_{10} and secondary nitrate particulate matter. Potential 24-hour concentrations for these pollutants were modeled for the special concern areas. These values were then applied in a comparison to background conditions (using monthly site-specific *f(RH)* relative humidity adjustments; EPA 2001) by calculating a potential change in deciview. Background seasonal extinction values from the FLAG (2000) Phase I Report were applied for all areas of special concern listed in Table 4.2-6. When not available for the specified area, background data from nearby areas were substituted. For the Savage Run Wilderness, background data from nearby Rawah Wilderness was applied. Similarly, background values from the Bridger and Fitzpatrick Wilderness Areas were substituted for the Popo Agie Wilderness and Wind River Roadless Areas, respectively.

For the Proposed Action alone, no impacts greater than the 0.5 or 1.0 Δ dv LAC thresholds were predicted. The maximum predicted impact was 0.4 Δ dv occurring at Popo Agie Wilderness. Table 4-7 lists the predicted maximum impacts for each special concern area.

Table 4-7. Predicted Visibility Impacts From the Proposed Action

Special Concern Area	Maximum Visibility Impact (Δ dv)	Visibility Significance Criteria (Δ dv)	Number of Days Greater than 0.5 Δ dv	Number of Days Greater than 1.0 Δ dv
Bridger Wilderness	0.4	0.5 / 1.0	0	0
Fitzpatrick Wilderness	0.4	0.5 / 1.0	0	0
Popo Agie Wilderness	0.4	0.5 / 1.0	0	0
Savage Run Wilderness	0.3	0.5 / 1.0	0	0
Wind River Roadless	0.4	0.5 / 1.0	0	0

Dry and Wet Deposition Impacts

Dry deposition fluxes were predicted for gaseous NO_x and nitric acid (HNO_3), as well as particulate nitrate (NO_3^-). Wet deposition fluxes were predicted for NO_3^-. Results are reported in total (wet + dry) nitrogen (N) deposition. Since the Proposed Action is not anticipated to be a substantial source for sulfur based chemical species, the calculation of sulfur deposition fluxes was not warranted.

Predicted total nitrogen deposition was compared to the USDA-Forest Service threshold value of 3 kg ha^{-1} yr^{-1}. (Fox et al 1989). Table 4-8 indicates that Proposed Action impacts on total nitrogen deposition are predicted to be below this threshold value for all areas of special concern.

Table 4-8. Proposed Action Impact on Total Nitrogen Deposition

Special Concern Area	Maximum Nitrogen Deposition (kg ha^{-1} yr^{-1})	Nitrogen Deposition Significance Criteria (kg ha^{-1} yr^{-1})	Maximum Percent of Threshold
Bridger Wilderness	2.46 E-03	3.0	0.08%
Fitzpatrick Wilderness	1.40 E-03	3.0	0.05%
Popo Agie Wilderness	2.54 E-03	3.0	0.08%
Savage Run Wilderness	1.30 E-03	3.0	0.04%
Wind River Roadless	1.62 E-03	3.0	0.05%

Acid Neutralization Capacity Impacts

An analysis of potential changes to Acid Neutralization Capacity (ANC) was performed for each of six sensitive lakes (Table 4-9) using the procedure recommended by the USDA – Forest Service (2000). This procedure incorporates predicted deposition results in a comparison to background ANC values for the lakes of concern. Calculated Proposed Action impacts were compared to a 10 percent change in ANC for lakes with background ANC values equal to, or above, 25 microequivalents per liter (μeq/l). For Upper Frozen Lake with a background ANC value of less than 25 μeq/l, the results were compared to a threshold of no more than one μeq/l total change in ANC. The results indicate that potential changes in lake ANC due to Proposed Action impacts alone are expected to be well below established LAC threshold values.

4.2.1.2 No Action Alternative

4.2.1.2.1 Air Quality Impacts

Impacts to air quality under the No Action Alternative would occur at levels similar in nature to, but on a smaller scale than, those described under the Proposed Action. Under this alternative, additional gas development could occur through the approval of individual wells on Federal lands. Development on State and private lands would continue though Wyoming Oil and Gas

Conservation Commission approval. No substantial air quality impacts are anticipated under this alternative.

Table 4-9. Proposed Action Impact on Acid Neutralization Capacity

Lake Name	Special Concern Area	Background ANC Concentration [a] (μeq/l)	Level of Acceptable Change	Proposed Action Change in ANC
Black Joe	Bridger Wilderness	69.0	10%	0.03%
Deep	Bridger Wilderness	61.0	10%	0.04%
Hobbs	Bridger Wilderness	68.0	10%	0.02%
Upper Frozen	Bridger Wilderness	5.8	1 μeq/l	0.02 μeq/l
Ross	Fitzpatrick Wilderness	61.4	10%	0.01%
Lower Saddlebag	Popo Agie Wilderness	55.5	10%	0.04%

[a] Data collected as part of the Draft Environmental Impact Statement for the Powder River Basin Oil and Gas Project (Bureau of Land Management 2002).

Air Quality Impacts Summary

No substantial adverse impacts to air quality are anticipated as a result of the Proposed Action and the No Action Alternative. Localized increases in NO_x, CO, and PM_{10} concentrations would occur under both Actions, but maximum concentrations would be below applicable Federal and State standards. Hazardous air pollutant health risks and incremental increases in cancer risk would be below applicable significance levels. Potential impacts to visibility, acid neutralization capacity, and total nitrogen deposition would be below the levels of acceptable change.

4.2.3 Mitigation Summary

Potential air quality impacts resulting from the Proposed Action could be reduced through the implementation of engineering control or other measures.

NO_x Mitigation

The primary sources of NO_x emissions associated with the Proposed Action are the natural gas-fueled compressor engines and well pump sources. The following potential mitigation measures could reduce impacts from NO_x emissions. The appropriate level of control will be determined and required by the WDEQ-AQD during the pre-construction permit process.

- In the permitting of compressor engines, the WDEQ-AQD always requires application of the Best Available Control Technology (BACT) process. As a result of the BACT process, emissions rates for compressor engines 100 hp and greater average 1.0 g/hp-hr NO_x. With the application of non-selective catalytic reduction, NO_x emissions for some compressor engines can be reduced to 0.7 g/hp-hr.

- Compressors and well pump sources powered by electric motors could reduce NO_x emissions within the immediate project area. However, increased NO_x emissions are likely to result at the point of electrical generation.
- Proposed Action related NO_x emissions could be offset through the application of controls at non-project sources.

Particulate Matter Mitigation

The primary Proposed Action related sources of particulate matter result from vehicle travel on unpaved roads and wind erosion. The following mitigation measures could reduce project related impacts from particulate emissions:

- Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by vehicle traffic.
- Water or other dust suppressants could be applied as necessary on unpaved roads and construction areas to reduce problem fugitive dust emissions.
- Operators could establish and enforce speed limits on all project related unpaved roads to reduce vehicle fugitive dust.

4.2.4 Residual Impacts

Implementation of the Proposed Action would result in minor increases in air pollutant emissions throughout the life of the project. As previously discussed, however, the increased pollutant concentrations resulting from the Proposed Action are not anticipated to exceed national standards (NAAQS) or PSD increments. Similarly, the Proposed Action is not likely to impact AQRVs such as visibility, acid neutralization capacity, or total nitrogen deposition at levels above the respective LACs.

4.3 SOILS

4.3.1 Impacts

4.3.1.1 Proposed Action

Impacts could occur to the soil environment as a result of the Proposed Action if during surface alteration land surfaces and gradients are steepen, which could increase runoff and erosion, or if soil cover is removed and the area is subject to accelerated erosion, undercutting, collapse or subsidence. The soils although clay-rich contain a mixture of eolian sand and are generally moderate to well drained. The underlying formations, particularly the Wasatch Formation, have a high clay content and areas where soil cover has been removed may become problematic or impassible immediately after heavy precipitation due to swelling clays.

4.3.1.2 No Action Alternative

Under this alternative, additional gas development could occur through the approval of individual wells on Federal lands. Development on State and private lands would continue though Wyoming Oil and Gas Conservation Commission approval. Impacts to the soils of the project area would be similar to those described under the Proposed Action, but to a lesser extent. The soils in the area are generally moderate to well-drained and with the exception of the eastern part of the area; the natural slope of the lands and underlying geologic dip is low thereby lessening the chance of flooding, erosion, or collapse or subsidence.

4.3.2 Mitigation

No additional mitigation to the soil environment is proposed.

4.3.3 Residual Impacts

No residual impacts to soils are identified.

4.4 WATER RESOURCES

4.4.1 Impacts

4.4.1.1 Proposed Action

4.4.1.1.1 Surface Water

Potential impacts that could occur to the surface water system due to the Proposed Action include increased surface water runoff and off-site sedimentation due to soil disturbance (Soils Section 4.3), water quality impairment of surface waters, and stream channel morphology changes due to road and pipeline crossings. The magnitude of the impacts to surface water resources would depend on the proximity of the disturbance to a drainage channel, slope aspect and gradient, degree and area of soil disturbance, soil character, duration of construction activities, and the timely implementation and success/failure of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would decrease in time due to stabilization, reclamation, and revegetation efforts. Construction activities would occur over a relatively short period of time; therefore, the majority of the disturbance would be intense but short-lived. Petroleum products and other chemicals could be accidentally spilled resulting in surface water contamination. Similarly, reserve and evaporative pits could leak if liners were punctured or no liners were installed, resulting in surface and subsurface water degradation.

The primary impact of the Proposed Action on surface water resources is the potential for increasing surface runoff, erosion, and off-site sedimentation that could cause channel instability and degradation of surface water quality. As described in Chapter 2, total new short-term surface disturbance resulting from the Proposed Action would be 583 acres (approximately 0.2 percent of the total CRPA which encompasses about 24,953 acres). This total would include 178 acres of new surface disturbance from well locations (including on-site gathering, measurement, and compressor facilities), 162 acres of new roads or upgrades of existing roads, and 243 acres of new pipeline construction. The construction disturbance would not be uniformly distributed across the project area, but rather, project facilities would be located where the efficiency and feasibility of extracting the natural gas would be the highest as discussed in Chapter 2. Locating of project facilities on slopes in excess of 25 percent would be avoided.

The primary roads utilized to access the CRPA are U.S. Highway 430, Sweetwater County Roads No. 4024 and 4-26, and existing lease roads (Figures 3-14 and 3-15). The Proposed Action area would encompass two existing oil and associated gas facilities and infrastructure currently accessed by an existing road network. The existing road network was developed to access prior and ongoing drilling and production activities, as well as other land use activities on Federal surface. All new access roads would be constructed specifically for shallow gas field development. The Proposed Action assumes the construction of no more than 89 wells and associated roads and pipelines. Roads would be designed to minimize disturbance, and all surface disturbance would be contained within the road ROW. In the event drilling is non-productive, all disturbed areas, including the well site and new access road, would be reclaimed to the approximate landform that existed prior to construction. If drilling is productive, all access roads to the well site would remain in place for well servicing activities. Partial reclamation would be completed on segments of the well pad and access road ROW no longer needed. The CRPA would have a maximum of 22.25 miles (81 acres) of new roads or upgrades of existing roads and 66.75 miles (242.7 acres) of new gas and water collection lines would be installed in a 30-foot wide facilities corridor. An average of 0.75 miles of new gas gathering and water discharge lines per well would be installed, of which approximately 0.5 miles would be constructed within existing pipeline corridors.

The majority of soil disturbance would be well away from stream channels as required by GRMP management directives identified in Section 4.4.2 (within 500 feet of live streams, lakes, reservoirs, canals and associated riparian habitat, and water wells; within 660 feet of springs or flowing artesian wells; and within 200 feet of intermittent and ephemeral streams). Authorization of the Proposed Action would require full compliance with the RMP management directives that relate to surface water protection, Executive Order 11990 (floodplains protection), and the CWA in regard to protection of water quality and compliance with Section 404 permits. These directives require avoidance of stream channels to the maximum extent possible. Where total avoidance is not possible, the minimization of impacts to streams and associated floodplains/floodways must be implemented and the operator would be required to show the BLM AO why such resources cannot be avoided and how impacts would be minimized. These regulations also require that certain permits/authorizations be obtained for project implementation including a NPDES permit (needed for surface discharge); development of a surface runoff, erosion, and sedimentation control plan; oil spill containment and contingency plan; as well as CWA Section 404 permits. Given these conditions, adverse sedimentation is not expected to occur as a result of the implementation of the Proposed Action.

Most of the ephemeral and intermittent drainage channels identified on Figure 3-3 are classified as waters of the U.S. Crossings of these channels and any associated wetlands would require authorization from the COE through the CWA Section 404 permitting process. However, these channel crossings would likely receive expedited authorization from the COE through Nationwide Permits No. 12 (buried utility lines) and/or No. 14 (minor road crossing fills) and No. 18 (minor discharges) as well as Programmatic General Permit 98-08. Other project facilities could not be located in waters of the U.S., and therefore, Section 404 permitting would not be necessary for such facilities. Each individual channel crossing would be reviewed during the APD/ROW permitting process for specific permit requirements under Section 404 and the CWA. Given these conditions, wetland damage is not expected to occur as a result of the implementation of the Proposed Action.

There is a remote chance that road and pipeline construction across established channels could adversely modify flow hydraulics. However, with correct design of channel crossings, including design for 25- to 50-year runoff events, no adverse impacts are expected. As discussed in Chapter 3, drainage channels in the project area are predominantly ephemeral to intermittent. Therefore, it is unlikely that increased sedimentation would adversely affect water quality of surface waters.

Reserve pits would be utilized to contain drilling fluids, cuttings, and water produced during drilling. The reserve pit would be lined as needed with an impermeable liner to prevent seepage. Bentonite or synthetic lining would be used where appropriate as defined during the APD review. The synthetic liner would be at least 12 mils thick, reinforced with a bursting strength of 174 x 175 pounds per inch (ASTMD 75719), resistant to decay from sunlight and hydrocarbons, and compatible with the drilling fluids to be retained. Leakage of the pit fluids would be minimal from lined reserve pits unless the liners were installed incorrectly or the liners were damaged during drilling operations. Thus, adverse impacts from leaks in lined reserve pits would likely not occur.

Water would be obtained from the water supply wells located in Section 10, T16N, R101W. The project would require approximately 252,000 gallons of water per well, assuming no re-use of drilling water, for completion, well stimulation and dust control. This water demand is relatively small and would not adversely affect existing surface or groundwater sources or rights.

Methods used for the disposal of produced water (water produced in association with the shallow gas which is separated out at the well location) would vary but would generally be accomplished by either disposal in an underground injection well or surface evaporation in lined or unlined ponds. The operator would obtain the permit(s) necessary for the selected disposal method. Depending on timing of availability, quantity, and quality of produced water; some of the produced water could be used in well drilling and completion, and pipeline construction and hydrostatic testing.

Handling and management of hydrostatic test water, if used by the operator, would be accomplished in a manner that does not adversely affect soils, stream channels, and surface water and groundwater quality. After testing operations are completed, the water would be pumped into water hauling trucks and transported to drilling locations within the project area and used in conjunction with the drilling operations. However, if such water is not re-used it would be disposed of in a manner where soil scouring and water quality impairment would not result. Hydrostatic test water would be evaluated for compliance with State water quality standards. No test water would be discharged unless such water meets these standards. Test water not needed for drilling operations that meets water quality standards would be disposed of onto undisturbed land having vegetative cover or into an established drainage channel in a manner as not to cause accelerated erosion.

If a well is productive, site erosion and off-site sedimentation would be controlled by promptly revegetating sites in the first appropriate season (fall or spring) after drilling, and providing surface water drainage controls, such as berms, sediment collection traps, diversion ditches, and erosion stops as needed. These measures would be described in the individual APD/ROW.

4.4.1.1.2 Groundwater

The primary impact of the Proposed Action on groundwater resources is best described as the loss of hydraulic pressure head in the affected coal seam aquifer. The removal of groundwater from the coal aquifer results in the reduction of the hydraulic pressure head, thus lowering the water levels in nearby wells completed in the same coal seam. The lowering of water levels in an aquifer is also referred to as drawdown.

A description of the geology and hydrology of the Copper Ridge Shallow Gas Project is given in Chapter 3. The focus of this groundwater impact assessment is the coal seam aquifers within the

Almond Formation, a member of the Upper Cretaceous Mesaverde Group. These targeted coal seams are classified as confined to semi-confined aquifers because they are bound by aquitards consisting of impervious to semi-pervious layers of shale and siltstone. Hydraulic connection between the Almond Formation coal seams and any aquifer stratigraphically above or below the coal seams is therefore very limited. The hydrostatic pressure head of the water measured in coal seam test wells completed in the project area can be considerably higher than the aquifer elevation at any respective well location. Confined, or artesian, aquifer conditions of this type are indicative of an effective seal or aquitard above and below the aquifer. However, lowering of the hydraulic pressure head in the coal seam aquifer by dewatering activities may induce a slight leakage of water through the semi-pervious shale layers into the pumped aquifer. Due to extremely low hydraulic conductivity of the confining layers, enhanced leakage from any aquifer stratigraphically above or below the dewatered coal seams would be minimal, and only after a period of time would drawdown effects in any overlying aquifer become apparent.

Currently, the lack of site-specific data within the project area does not justify the use of a three dimensional groundwater drawdown model, such as the U.S. Geological Survey's Three Dimensional Finite Difference Modular Groundwater Flow Model, MODFLOW (McDonald & Harbaugh, 1988) to predict drawdown impacts. The data necessary for a model of this type includes elevations, hydraulic conductivities and potentiometric surfaces for the coal seam(s) and confining layers. Until additional drilling and testing are conducted and data of these types are collected, the use of a simpler planning-level model is justified. Therefore, the aerial extent of drawdown within the coal aquifer due to the removal of water for the shallow gas project was estimated using an aquifer analysis model that is based on equations describing transient flow to pumping wells developed by Theis (1935). This model provides a conservative prediction of look at potential drawdown resulting from groundwater pumpage at a well or group of wells. The assumptions used with this model are that the aquifer is isotropic (aquifer properties do not vary with direction), homogeneous (aquifer properties do not vary with location), of infinite aerial extent, and lies horizontally. Obviously, these simplifying assumptions are not met by the Almond Formation coal seams. Use of these simplifying assumptions is likely to result in a conservative analysis, with drawdowns overstated as compared to what are likely to occur. As described below, the aquifer's hydraulic and physical parameters used in the model were derived from both the literature and from actual field measurements.

It was further assumed that the aquifer is confined (a storage coefficient of 0.0002 was used) and that the confining layers are leaky. The available head, which is the height to which water would rise measured from the bottom of the aquifer, was estimated using the hydrostatic pressure heads gauged in existing shallow gas wells.

Long-term, steady state shallow gas well water production data within the Proposed Action area is presently unavailable. Short-term tests on recently completed shallow gas wells indicate that discharge rates are highly variable. An anticipated steady-state discharge rate of seven gallons per minute (gpm) was assigned to each of the 89 shallow gas well locations to simulate the Proposed Action. The locations of these 89 pumping wells were distributed in the locations proposed in the Copper Ridge Unit Field Map. The model simulated these 89 wells pumping continuously for a period of 10, 20, and 30 years. The resulting average extent of drawdown was then contoured, as shown in Figure 4-1. In reality, discharge rates may exceed this amount at the onset of production but would decline over time, likely reaching zero in the later stages of the project. This is because as the formation pressures drop, the gas would begin to flow more freely into the well and much less water would need to be produced.

This model predicts that, after 30 years the 10-foot drawdown contour in the coal would extend approximately 14 miles north, 14 miles west, and 12 miles south of the Copper Ridge shallow gas project area. Ten feet of drawdown represents less than one percent of the estimated available head in this area. Water levels are predicted to decline as much as 2,000 feet at Black Butte Creek within the CRPA (Figure 4-1).

Due to the approximate nature of the Theis aquifer model, drawdowns predicted between the CRPA and the coal seam outcrop, are simplified. The total available drawdown between the project area and the coal outcrop/subcrop trace is unknown, and it is conservatively assumed that the affected coal seam would be completely dewatered in these areas. Again, in light of the available data the Theis model was considered to be the best representation of the dewatering stresses imposed by the proposed shallow gas project. With more data available in the future, a numerical model (e.g., MODFLOW) may be applied.

The reduction of hydraulic pressure head in the affected coal seam aquifer would mean that any well completed in the same coal seam within the area of influence may be impacted. As described in Chapter 3, there are currently no active permitted water wells located within the CRPA. There are five permitted water wells located within the projected 10-foot drawdown area; however, the well completion information from the SEO records is too vague to determine whether or not an Almond coal seam is the contributing aquifer. Nevertheless, the wells are located such that if they are completed within an affected coal seam, the probability is high that they would be impacted.

No springs or seeps have been identified within the project area. If any should be discovered during the life of the project, the exact locations and associated water-bearing strata of such surface expressions of groundwater would be evaluated during the site-specific analysis conducted for all components at the APD stage. Due to coal seam depths in the CRPA, it is unlikely that drawdown in the coal seam would adversely affect springs or seeps in the project area if any were to be located. Further, all construction activities and storage of petroleum products would be kept away from any seeps and springs (a minimum distance of 200 to 600 feet depending on the type of spring); therefore, contamination would be unlikely.

In addition to drawdown in the affected coal seam aquifer, the geologic unit(s) chosen for the subsurface disposal of shallow gas produced water would also be affected. At this time, little data are available to describe the geologic unit(s) that would be the injection target. Data would be collected on potential host units during the drilling and completion of the shallow gas wells and the new disposal/injection wells, if needed. Information from the these sources would allow the operator to more accurately predict shallow gas water production data and the depths, hydrostatic pressures, permeabilities, and other technical information necessary to assess impacts to subsurface geologic units chosen as injection zones. In general, the principle impact resulting from subsurface water disposal would consist of an increase in hydrostatic pressure in the geologic unit(s) chosen as the injection zone. It is unlikely that the water quality of the native groundwater in the host aquifer(s) would be degraded because the produced water would be of equal or higher quality than that of the injection zone. The produced water would be gathered from aquifers that occur at shallow depths in relatively close proximity to recharge areas, where

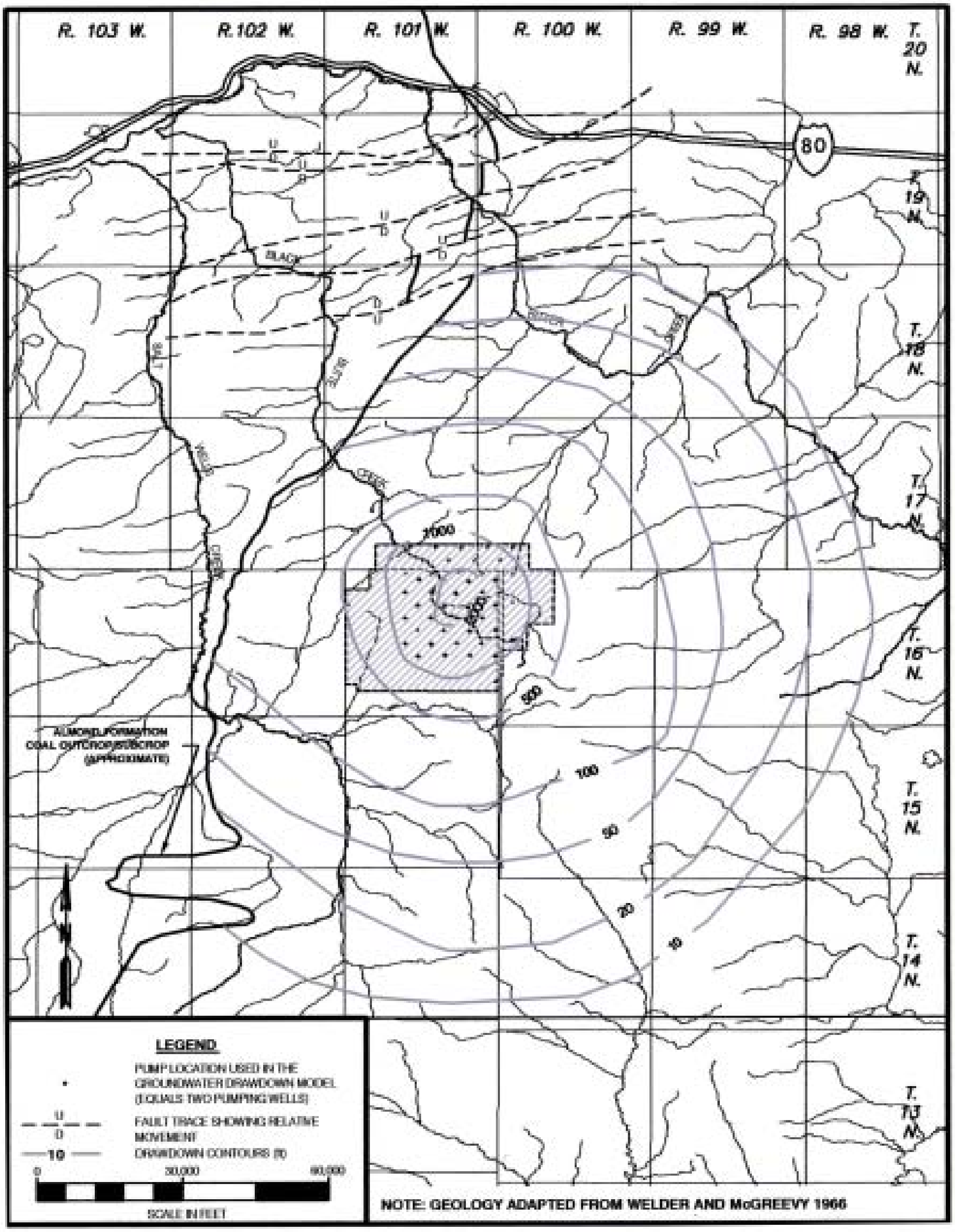


Figure 4-1. Modeled Maximum Extent of Drawdown Within the Almond Formation Coal Aquifer Due to the Proposed Action.

groundwater would be fresher and have smaller concentrations of dissolved solids relative to that of aquifer occurring at greater depth that would be targeted for disposal.

Groundwater from the deeper host aquifer(s) is further from recharge areas and as a result of increased contact time with the host rock would have higher dissolved solids concentrations than groundwater occurring in shallower aquifer units.

In the event that an injection well ceases to operate properly due to formation over-pressuring or mechanical failure, the operator must still remain in compliance with all applicable regulations governing the operation of the produced water disposal system. Compliance options available to the operator include curtailing or halting the rate of water production or routing the discharge to additional injection wells.

Well drilling and completion should not have an adverse effect on groundwater quality. Poor drilling and completion techniques could result in degradation of groundwater due to the mixing of variable quality waters from different water-bearing strata that happen to be pierced by the borehole. The magnitude of mixing, if any, which would occur during the relatively short period of time during drilling, should be relatively small. In addition, due to the state-of-the-art drilling and well completion techniques, the possibility of serious degradation of groundwater quality by the Proposed Action would be very low. The improbable degradation of groundwater quality within any aquifers in the project area essentially eliminates the possibility of adverse effects to the identified water rights holders (Chapter 3).

4.4.1.2 No Action Alternative

Impacts to water resources with implementation of No Action would be similar to the Proposed Action but of a lesser magnitude.

4.4.2 Mitigation

The following measure would further reduce potential impacts.

Should existing water wells be adversely affected by the project, the company should rework, replace, or otherwise compensate the well owner.

4.4.3 Residual Impacts

No residual impacts would result from project implementation.

4.5 VEGETATION, WETLANDS AND NOXIOUS WEEDS

4.5.1 Impacts

4.5.1.1 Proposed Action

Potential impacts to existing native shrub/grassland communities resulting from project implementation may include direct impacts such as disturbance, reduction, and/or removal of vegetation. Potential indirect impacts to the vegetation resource may occur as a result of soil compaction, mixing of soil horizons, loss of topsoil productivity, increased soil surface exposure, soil loss due to wind and water erosion, and damage to biological soil crusts (Belnap et al. 2001). .

The proposed action assumes construction of 89 wells and associated roads and pipelines. Construction and installation of well sites, access roads, and ancillary facilities (including pipelines) would directly reduce the extent of vegetation cover types. Over the estimated 2-4 year development phase, the Proposed Action would involve surface disturbance of about 502 acres (2.6% of the CRPA). This disturbance would be distributed among the primary and secondary vegetation types on the CRPA identified by the Wyoming GAP Analysis (Merrill et al. 1996). For purposes of this analysis it was assumed that disturbance associated with access roads and pipelines would be located in the same vegetation cover type as the proposed well location.

Analysis of initial construction disturbance upon vegetation cover types is based on the approximate location of proposed wells prior to construction; actual placement of wells may change as development proceeds. As shown in Table 4-10, of the 89 proposed wells, 86 would be located in the Wyoming big sagebrush primary cover type with a total disturbance of 485.1 acres or 2.0 percent of this cover type. Three wells would be located in the desert shrub primary vegetation cover type with a total disturbance of 16.9 acres or about 2.6 percent of this primary cover type.

Fifty-four wells would be located in the mixed grass prairie secondary cover type with a total disturbance of 304.5 acres or about 1.7 percent of this secondary cover type. Three wells would be located in the Wyoming big sagebrush secondary cover type with a total disturbance of about 16.9 acres which represents about 2.6 percent of this secondary cover type. Thirty-two wells would be located in the desert shrub secondary cover type which represents about 2.9 percent of this secondary cover type.

During the production phase of the project, pipelines and about one acre of each initial two acre well pad area would be reclaimed. Therefore, total vegetation disturbance would be reduced from an initial 502 acres to about 170.8 acres after successful reclamation and during the LOP.

In general, the extent of these impacts would be influenced by success of mitigation and reclamation efforts and the time period required for disturbed areas to return to pre-existing conditions. Reclamation success, in part, depends on the amount of surface area disturbed and quality of topsoil salvaged and stockpile/redistribution methods in disturbed areas, precipitation, soil type, and moisture availability. Reseeding and reclamation efforts could proceed after cessation of surface-disturbing activities and original contour and grade are achieved as discussed in Section 2.1.10.

Except for riparian/wetland and plant species of concern sites, disturbance of the upland Wyoming big sagebrush/mixed grass prairie vegetation type would be minor because of its abundance and wide area of distribution in this area of southwestern Wyoming. Despite the difficulty of establishing vegetation in upland Wyoming big sagebrush/grassland sites with <10 inches average annual precipitation, current technology exists to stabilize these areas and minimize soil erosion as natural succession returns the site to pre-existing conditions. Any potential impacts would be minimized assuming construction, maintenance and operation of well pad sites and associated disturbances are in accordance with Chapter 2 of this EA, Anadarko's APDs, and RMP requirements.

Table 4-10. Summary of Potential Vegetation Impacts (acres) with Implementation of the Proposed Action.*

Vegetation Cover Type[A]	Area[A]	Well Pads #	Well Pads ac[B]	Roads (ac)[C]	Pipeline (ac)[D]	Total Acres	%[E]
PRIMARY COVER							
Wyoming big sagebrush	24304.2	86	172.0	78.3	234.8	485.1	2.0
Desert shrub	648.8	3	6.0	2.7	8.2	16.9	2.6
Total	24953.0 (24782.2)[F]	89 (89)	178.0 (89.0)	81.0 (81.0)	66.8 (0.0)	502.0 (170.8)	2.0 (0.7)
SECONDARY COVER							
Mixed grass prairie	18041.0	54	108.0	49.1	147.4	304.5	1.7
Wyoming big sagebrush	648.8	3	6.0	2.7	8.2	16.9	2.6
Desert shrub	6263.2	32	64.0	29.1	87.4	180.5	2.9
Total	24953.0 (24782.2)	89 (89)	178.0 (89.0)	81.0 (81.0)	243.0 (0.0)	502.0 (170.8)	2.0 (0.7)

***NOTE:** Averages may differ slightly from those shown in Table 2-1 due to rounding differences, use of significant numbers, and the exclusion of the compressor site (0.9 acres) which would be located on private land.
[A] Merrill et al. (1986).
[B] Assumes an initial disturbance of about 2.0 acres per well pad and LOP disturbance of one acre per well pad.
[C] Assumes an average of 0.25 mi of new road with parallel gas gathering and water discharge lines (60 foot avg. disturbance width) per well. All disturbance except for the estimated 30 foot wide road and adjacent ditches would be reclaimed during the LOP.
[D] Assumes and average of 0.75 mile (avg. disturbance width of 30 feet) of new gas gathering and water discharge lines per well, of which about 0.50 mile would be constructed using existing pipeline corridors.
[E] Percentage of each vegetation type disturbed.
[F] Estimated life-of-project (LOP) total disturbances are enclosed in parenthesis, based upon assumptions stated above ([B, C,] and [D]).

Wetlands

Due to a paucity of wetland/riparian sites on the CRPA, the probability of well pads, roads, or pipelines impacting these resources is low. The RMP specifies that a 500 foot (minimum) buffer around riparian and other water resources would be maintained. Permits under Section 404 of the Clean Water Act would be required for any activities in wetlands. Anadarko would be required to demonstrate to the Army Corps of Engineers (COE) that there are no "practical alternatives" to placement of a well location in a wetland. The probability of impacting wetlands and other waters of the U.S. under the Proposed Action is low given the xeric nature of the CRPA and identified mitigation procedures stated in Chapter 2, Anadarko's APD's, the RMP, COE and BLM surface- disturbing guidelines.

Noxious Plant Species

Surface disturbing activities could increase the potential for infestation and spread of invasive (includes noxious) plant species. Invasive species, especially weeds, usually thrive on newly disturbed surfaces such as road and pipeline ROW's and out-compete more desirable plant species. As explained in Section 2.2.2.12.13, Anadarko would be responsible for the management and control of all invasive (including noxious) weed species infestations on project-related surface disturbances during the projected LOP and would consult with the BLM Authorizing Officer (AO) and/or local Sweetwater County Weed and Pest Control District authority for acceptable weed control methods.

Appendix 9-2 of the RMP provides guidelines for herbicide utilization within the RSFO management area. In addition, Appendix 5-1 of the RMP specifies that herbicide loading sites would be located at least 500 feet from live water, floodplains, riparian areas, and all special status plant locations. In addition, aerial spraying of chemicals would be prohibited within 1/4 mile of special plant locations, and hand application would be prohibited within 500 feet. Control measures would adhere to those allowed in the *FEIS, Vegetation treatment on BLM lands in the thirteen western states* (USDI-BLM 1991).

4.5.1.2 Alternative A - No Action

Under the No Action Alternative, direct and indirect vegetation impacts would continue as additional individual exploratory and development activities beyond this EA are considered by the BLM on a case-by-case basis for individual APDs on federal lands. Additional gas development would occur on State and private lands within the CRPA under APDs approved by the WOGCC. Transport of natural gas products would be allowed from those wells in the CRPA that are in current production. Table 4-11 summarizes potential impacts under the No Action alternative.

The No Action alternative assumes construction of 48 wells and associated roads and pipelines. Construction and installation of well sites, access roads, and ancillary facilities (including pipelines) would directly reduce the extent of vegetation cover types. Over the estimated 2-4 year development phase of the project, the No Action alternative would involve a total initial disturbance of about 337 acres (Table 4-11) or about 1.4% of the CRPA's total land surface. Through successful reclamation of pipeline ROW's and about 1 acre per well pad, the total disturbed acres over the LOP would be reduced to about 92 acres.

As shown in Table 4-11, of these 48 proposed wells, 47 would be located in the Wyoming big sagebrush primary cover type with a total disturbance of 331.3 acres or 1.4% of this primary cover type. One well would be located in the desert shrub primary cover type with a total initial disturbance of 5.6 acres or about 0.9% of this primary cover type.

Twenty-one wells would be located in the mixed grass prairie secondary cover type with a total initial disturbance of 118.4 aces or about 0.7% of this secondary cover type. One well would be located in the Wyoming big sagebrush secondary cover type with a total initial disturbance of 5.6 acres or about 0.9% of this secondary cover type. Twenty-six wells would be located in the desert shrub secondary cover type with a total initial disturbance of 146.7 acres or about 2.3% of this secondary cover type.

Potential impacts to wetlands and waters of the U.S., federally listed plant species, BLM plant species of concern, and invasive plants would remain unchanged from those of the Proposed Action. However, federal disturbed acres under the No Action alternative would be reduced about 72% from an initial 231 acres of the Proposed Action to 65 acres under the No Action alternative. During the LOP, these 65 acres are estimated to stabilize at about 16.4 acres, assuming a successful reseeding and reclamation program.

Table 4–11. Summary of Potential Vegetation Impacts (acres) under the No Action Alternative.

Vegetation Cover Type[A]	Area (ac)[A]	Well Pads #	Well Pads ac[B]	Roads (ac)[C]	Pipeline (ac)[D]	Total Acres	%[E]
PRIMARY COVER							
Wyoming big sagebrush	24304.2	47	94.0	59.9	177.4	331.3	1.4
Desert shrub	648.8	1	2.0	0.9	2.7	5.6	0.9
Total	24953.0 (24861.1)[F]	48 (48)	96.0 (48)	60.8[G] (43.7)	180.1[G] (0.0)	336.9[G] (91.7)	1.4 (0.4)
SECONDARY COVER							
Mixed grass prairie	18041.0	21	42.0	19.1	57.3	118.4	0.7
Wyoming big sagebrush	648.8	1	2.0	0.9	2.7	5.6	0.9
Desert shrub	6263.2	26	52.0	23.7	71.0	146.7	2.3
Total	24953.0 (24861.3)	48 (48)	96.0 (48)	60.8[G] (43.7)	180.1[G] (0.0)	336.9[G] (91.7)	1.1 (0.4)

***NOTE:** Averages may differ slightly from those shown in Table 2-1 due to rounding differences, use of significant numbers, and the exclusion of the compressor site (0.9 ac).

[A] Merrill et al. (1986).

[B] Assumes an initial disturbance of about 2.0 acres per well pad and LOP disturbance of one acre per well pad.

[C] Assumes and average of 0.25 mile of new road with parallel gas gathering and water discharge lines (60 foot avg. disturbance width) per well. All disturbances except the estimated 30 foot wide road and adjacent ditches would be reclaimed during the LOP.

[D] Assumes an average of 0.75 mile (30 ft. avg. disturbance width) of new gas gathering and water discharge lines per well, of which, about 05 mile would be constructed using existing pipeline corridors.

[E] Percentage of each vegetation type disturbed.

[F] Estimated LOP total disturbance enclosed in parenthesis, based upon assumptions stated in [B, C, and D.]

[G] Totals reflect disturbed state and private acres and includes about 65.4 federal acres disturbed by roads (16.4 ac) and pipelines (49.1 ac).

4.5.2 Mitigation

No additional mitigation would be required.

4.5.3 Residual Impacts

No residual impacts to the vegetation resource would take place with implementation of and compliance with mitigation measures and stipulations stated in Chapter 2 of this EA, Anadarko's APDs, and the RMP, realizing that full reclamation to pre-existing vegetation conditions (especially the shrub component) may require several decades in the arid environment of the project area, dependant in great part, to future climatic conditions and land-use patterns.

4.6 RANGE RESOURCES

4.6.1 Impacts

4.6.1.1 Proposed Action

Under the Proposed Action, an estimated 503 total (federal, state, private) acres would initially be disturbed which represents about 0.03% of the total land area (1,913,364 acres) of the Rock Springs grazing allotment. During the LOP, this total is estimated to decrease to about 171 acres which represents about 0.009% of the total land area of the allotment.

Sheep and cattle grazing would continue throughout the duration of the project. The primary impact to grazing resources would be short-term loss of available forage as a result of construction and production-related disturbance. Table 4-12 summarizes and compares, both for the Proposed Action and the No Action Alternative, the estimated initial disturbed acres with those during the LOP and corresponding AUM impacts.

Assuming all 89 wells are successful, the Proposed Action would result in an estimated initial 503.0 acres of short-term disturbance (about 2.0% of the total project area) or about 0.03% of the 1,913,364 acres encompassed within the Rock Springs grazing allotment (Lloyd 2003). During the anticipated LOP, this total is estimated to decrease to about 170.8 acres (0.7% of the total project area) or about 0.009% of the total land area of the grazing allotment.

The average stocking rate for the Rock Springs grazing allotment is about 14 acres per AUM (Lloyd 2003). Consequently, the Proposed Action would result in a short-term loss of about 35.9 AUMs, and a long-term loss of about 12.2 AUMs. These losses would amount to substantially less than one percent of the permitted 180,234 AUM's for the Rock Springs allotment (Lloyd 2003). Depending upon the success of drilling productive wells, long-term reduction of AUMs could be less than currently calculated. For example, in the existing Brady and Jackknife Spring Field's, 8 out of 59 wells drilled (14%) since 1972 were dry holes, and have been subsequently plugged, abandoned, and reclaimed. If 14% of the proposed new 89 wells are non-producing, an additional 12-13 well pads with their associated facilities and access roads would be reclaimed earlier in the LOP process resulting in increased available forage in a shorter time span than currently projected.

Under the Proposed Action, the estimated initial and LOP disturbed acres and associated AUM reductions represent less than 1.0% of the total land area and permitted AUMs, respectively.

Successful reclaimed sites produce at a rate of about 6 acres per AUM (PFO-BLM 1997) which is more than twice the present 14 acres per AUM stocking rate for the Rock Springs allotment. Reclamation of disturbed sites with grasses and forbs could cause a localized increase in the availability of livestock forage and depending upon the intensity of use (grazing by wildlife, wild horses, and livestock) could interfere with revegetation success of reclaimed areas and fencing may be required to avoid overuse and to assure successful reclamation of the site. Prevention and control of invasive weed species would be a positive impact to livestock by reducing competition with indigenous plants, thereby maximizing forage production.

The Proposed Action increases the potential for livestock/vehicle collisions. However, if Anadarko advises project personnel regarding appropriate speed limits on designated access roads and these instructions are complied with, the likelihood of livestock/vehicle collisions would be minimized.

Table 4-12. Estimated Reduction of Animal Unit Months in the Rock Springs Grazing Allotment (13017) due to Land Surface/Vegetation Disturbance for the Proposed Action and No Action Alternatives.

Land Ownership Status	Estimated Total Initial Disturbed Area (acres)	Estimated Total Initial Animal Unit Months (AUM) Reduction	Estimated Total Life-of-Project (LOP) Disturbance Area (acres)	Estimated Total Life-of-Project (LOP) Animal Unit Months (AUM) Reduction
PROPOSED ACTION				
Federal	231.1[1](0.01%)[2]	16.5[3] (0.01%)[4]	78.3 (0.004%)	5.6 (0.004%)
State	11.3 (0.0006%)	0.8 (0.0006%)	3.8 (0.0002%)	0.27 (0.0001%)
Private	260.2 (0.01%)	18.6 (0.01%)	88.7 (0.005%)	6.3 (0.0002%)
TOTAL	**502.6 (0.03%)**	**35.9 (0.024%)**	**170.8 (0.009%)**	**12.2 (0.006%)**
NO ACTION ALTERNATIVE				
Federal	65.5 (0.003%)	4.7 (0.0024%)	16.4 (0.009%)	1.2 (0.0006%)
State	31.3 (0.002%)	2.2 (0.002%)	3.8 (0.0002%)	0.27 (0.0001%)
Private	260.2 (0.01%)	18.6 (0.01%)	88.7 (0.005%)	6.3 (0.0002%)
TOTAL	**357.0 (0.02%)**	**25.5 (0.016%)**	**108.9 (0.006%)**	**7.8 (0.004%)**

[1] See Table 2-1 (p. 2-4) for individual gas field component acreage (e.g., compressor station, road and pipeline construction, well pads, etc).

[2] Percentage (in parenthesis) of total acres affected based on an estimated total of 1,913,364 acres within the Rock Springs Grazing Allotment (K. Lloyd, RSFO-BLM, Pers. Comm. 2003).

[3] AUMs calculated for Rock Springs Grazing Allotment based on historical stocking rate of 14 acres per AUM and 1 AUM = 780 lbs forage/month (K. Lloyd, RSFO-BLM, Per. Comm. 2003).

[4] Percentage (in parenthesis) of affected Animal Unit months (AUM) based on total of 180,234 AUMs permitted for the Rock Springs Grazing Allotment (K. Lloyd, RSFO-BLM, Pers. Comm March 2003).

4.6.1.2 Alternative A - No Action

Impacts resulting from the implementation of this alternative would be similar, but reduced in scope, to those described under the Proposed Action. Under the No Action Alternative, disturbances to the rangeland resource located in proximity to roads and existing facilities would continue due to vehicular use and continued gas field-related activities. Consideration of individual APDs by the BLM on federal lands could continue on a case-by-case basis through individual project and site-specific environmental analysis. Additional gas development could occur on State and private lands within the CRPA under APDs approved by the WOGCC.

Under the No Action Alternative, an estimated 357 acres (Proposed Action = 583 acres) would be disturbed initially due to continuing gas-related activity which represents about 1.4% of the CRPA and about 0.02% of the total land area of the Rock Springs grazing allotment. As site reclamation proceeds, the estimated LOP disturbance acres is reduced from 337 to 109 acres which represents about 0.43% 0f the CRPA and 0.006% of the total land area of the Rock Springs grazing allotment (Table 4-13).

Under the No Action Alternative, the estimated reduction of initial AUMs would be about 25.5 AUMs which represent about 0.02% of the total permitted AUMs for the Rock Springs grazing allotment. The estimated LOP reduction in total AUMs would stabilize at about 7.8 AUMs or about 0.005% of the total permitted AUMs for the Rock Springs grazing allotment (Table 4-13).

4.6.2 Mitigation

No additional mitigation would be required.

4.6.3 Residual Impacts

No adverse residual impacts are expected to occur as a result of project implementation, provided the guidelines and mitigation measures provided in this document and the RMP are successfully implemented.

4.7 WILDLIFE

4.7.1 Impacts

4.7.1.1 Proposed Action

Over the four-year proposed drilling period, approximately 89 wells would be drilled, disturbing approximately 583.4 acres of general wildlife habitat. The precise number and location of wells may change as directed by the success of developmental drilling, production technology, and economic profitability.

During the production phase, the unused portion of well sites and roads, as well as pipelines (a total of 331.7 acres) would be reclaimed leaving up to 170.8 acres disturbed over the LOP. Following completion of production operations (life of the project is estimated at 15-20 years), the well field and ancillary facilities would be reclaimed and abandoned. Well pads would be removed and the areas revegetated with seed mixes approved by the BLM, some of which are specifically designed to enhance wildlife use. The duration of impacts to vegetation would depend, in part, on the success of mitigation and reclamation efforts and the time needed for natural succession to return revegetated areas to predisturbance conditions. Grasses and forbs are expected to become established within the first several years following reclamation; however, much more time would be required to achieve reestablishment of shrub communities. Consequently, disturbance of shrub communities, particularly mixed shrub communities that big game utilize during winter, would result in a long-term loss of those habitats.

In addition to the direct loss of habitat due to construction of well pads and associated roads and pipelines, disturbances from human activity and traffic would lower the utilization of habitat immediately adjacent to these areas. Species that are sensitive to indirect human disturbance (noise and visual disturbance) would be impacted most. Habitat effectiveness of these areas would be lowest during the construction phase when human activities are more ubiquitous and intensive. Disturbance would be reduced during the production phase of operations and many animals may become accustomed to equipment and facilities in the gas field and may once again use habitats adjacent to disturbance areas.

4.7.1.1.1 General Wildlife

The direct disturbance of approximately 583.4 acres of wildlife habitat under the Proposed Action would reduce habitat availability and effectiveness for a variety of common small mammals, birds and their predators. The initial phases of surface disturbance would result in some direct mortality and displacement of songbirds and small mammals from construction sties. In addition, some increase in mortality from increased vehicle use of roads in the project area is expected. Quantification of these losses is not possible; however, the impact is likely to range from low to moderate over the short-term. Due to the relatively high production potential of these species and the relatively small amount of habitat disturbed, small mammal and songbird populations would quickly rebound to pre-disturbance levels following reclamation of pipelines, unused portions of roads, well pads, and wells that are no longer productive. No long-term adverse impacts to populations of small mammals and songbirds are expected.

4.7.1.1.2 Big Game

In general, impacts to big game wildlife species would include direct loss of habitat and forage, and increased disturbance from drilling, construction, and maintenance operations. Disturbance of big game species on winter range can increase stress and may influence species distribution (Hayden-Wing 1980, Morgantini and Hudson 1980). There may also be a potential for an increase in poaching and harassment of big game, particularly during winter. The potential for vehicle collisions with big game would likely increase as a result of increased vehicular traffic and speeds associated with the presence of construction crews and would continue (although at a reduced rate) throughout all phases of the operations.

Mule Deer. The project area supports mule deer year round. Approximately 5% of the project area is classified as mule deer crucial winter/yearlong range and 95% of the project area is classified as mule deer winter yearlong range. An estimated four wells would be located in mule deer crucial winter/yearlong range; total disturbance associated with these wells would be approximately 28.2 acres (Table 4-13), or 2.5% of the crucial winter/yearlong range in the project area. Following reclamation, approximately 8.2 acres of crucial winter/yearlong range would remain disturbed for the remaining life of the project. An estimated eighty-five wells would be located in winter yearlong range, disturbing a total of 555.2 acres, or 2.3% of the winter yearlong range in the project area.

During winter, mule deer primarily utilize shrubs including sagebrush, mountain mahogany, and antelope bitterbrush (DeBolt 2000). Mountain mahogany is also an important mule deer forage during the spring, summer, and fall (DeBolt 2000). Specific placement of roads and wells to avoid destroying habitat patches containing these shrub species would lessen the impact upon the crucial winter range vegetation in the project area. Overall, impacts upon mule deer winter habitat should be limited and no long-term impacts to mule deer in the area are expected because a very small percent (2.5%) of the crucial winter/yearlong range would be disturbed and similar habitats are available in the surrounding area.

Table 4-13. Summary of Impacts (Acres) on Big Game Seasonal Ranges with Construction of the Proposed Action.

Species Range Type	Area (ac)	Well Pads #	 ac	Roads (ac)	Pipelines (ac)	Compressor (ac)	Total (ac)	%[1]
Mule Deer								
Crucial Winter Yearlong	1108	4	8	8.1	12.1	0	28.2	2.5
Winter Yearlong	23845	85	170	153.7	230.6	0.9	555.2	2.3
Totals	24953	89	178	161.8	242.7	0.9	583.4	2.3
Elk								
Yearlong	55	0	0	0	0	0	0	0
Undetermined	24898	89	178	161.8	242.7	0.9	583.4	2.3
Totals	24953	89	178	161.8	242.7	0.9	583.4	2.3
Pronghorn Antelope								
Winter Yearlong	22520	80	160.2	145.6	218.4	0.9	525.1	2.3
Crucial Winter/Yearlong	2433	9	17.8	16.2	24.3	0	58.3	2.4
Totals	24953	89	178	161.8	242.7	0.9	583.4	2.3

[1] - Percentage of each type disturbed

Disturbance is also a factor that should be considered for big game species. According to management directives in the RMP, crucial big game winter ranges will be closed from November 15 - April 30. This closure of areas located in mule deer crucial winter/yearlong range would reduce disturbance to mule deer wintering on the project area. No adverse impacts upon the mule deer population utilizing the project area are expected provided that mitigation measures contained in this document and the RMP are implemented.

Elk. Very little of the project area supports elk during anytime of the year with less than 0.1% of the project area classified as yearlong elk winter range. The remainder of the project area (over 99%) is of undetermined value and has not been classified as any type of elk seasonal range. Therefore, nearly all of the disturbance associated with the project would occur in areas of undetermined value to elk.

During winter, elk utilize most of the same shrub species preferred by mule deer, but prefer grasses when they are available. Spatial separation of elk and mule deer on the winter range may occur (Hayden-Wing 1980), but they often utilize the same areas (DeBolt 2000). Overall, impacts upon elk habitat would be negligible.

Pronghorn. The project area supports pronghorn throughout the year. Approximately 90% of the project area is classified as winter yearlong pronghorn range, and approximately 10% of the project area is classified as crucial winter/yearlong pronghorn range. An estimated 80 wells would be located in winter yearlong pronghorn range; total disturbance associated with these wells would be approximately 525.1 acres (Table 4-13), or 2.3% of the winter yearlong pronghorn range in the project area. Following reclamation, approximately 152.3 acres of winter yearlong pronghorn range would remain disturbed for the remaining life of the project. An estimated 9 wells would be located in crucial winter/yearlong pronghorn range; total disturbance associated with these wells would be approximately 58.3 acres, or 2.4% of the crucial winter/yearlong pronghorn range in the project area. Following reclamation, approximately 16.9 acres of crucial winter/yearlong pronghorn range would remain disturbed for the remaining life of the project.

Pronghorn crucial winter/yearlong range is located only in the northern portion of the project area and winter yearlong range covers the remainder of the project area. Activities associated with the construction phase of the project would likely temporarily displace pronghorn, however, once construction is complete pronghorn would likely habituate and return to pre-disturbance activity patterns. Reeve (1984) found that pronghorn acclimated to increased traffic volumes and machinery as long as the traffic and machines moved in a predictable manner. The displacement of pronghorn and disturbance of habitats is considered a short-term impact because of the temporary nature of the displacement and the availability of comparable habitats in adjacent areas.

4.7.1.1.3 Upland Game Birds

Greater Sage-grouse. Under the Proposed Action, 583.4 acres of the Wyoming big sagebrush vegetation cover type would be disturbed during construction and 170.8 acres in the long-term if all wells were productive. This amount of habitat disturbance is minimal (0.7% long-term) considering the amount available in the project area, however, sage grouse can be impacted by other activities associated with development including increased human activity, increased traffic disturbance, and pumping noises. Sage grouse exhibit site fidelity to leks, winter areas, summer areas, and nesting areas (Eng 1963, Dunn and Braun 1985). Therefore, steps, i.e. those described in Section 2.1.11.2.9, would ensure that impacts to these areas, especially leks and nesting areas, are minimized. Four active sage grouse leks have been identified on or within two miles of the project area (Figure 3-11).

Additional surface disturbance would be avoided within 1/4 mile of the two sage grouse leks within the project area boundary. Approximately 251 acres in the project area are located within the 1/4-mile buffer of those lek locations. Additionally, construction activities within a two-mile radius of active leks would be restricted between March 1 and June 30 to provide protection for grouse during the egg-laying and incubation period. Exceptions may be granted if the activity will occur in unsuitable nesting habitat. If all avoidance and mitigation measures identified in this document and the RMP are implemented, impacts to greater sage-grouse are expected to be minimal.

Mourning Dove. Mourning doves are known to breed in areas west of the project area, and it is likely that some limited breeding activity and nesting occurs on the project area. The project area is located in UGMA #6, in which only 1.8% of the state's total harvest of mourning doves occurred in 2001 (WGFD 2002b). Mourning dove habitat on the project area is marginal in quality and disturbances that may occur are not expected to impact this species.

4.7.1.1.4 Waterfowl and Shorebirds

Habitat for waterfowl and shorebirds is very limited on the project area. Given mitigation measures for water resources identified in this document and in the RMP, it is expected that the Proposed Action would not have impacts upon waterfowl or shorebirds.

4.7.1.1.5 Raptors

The potential impacts of the Proposed Action on raptors are : (1) nest abandonment and/or reproductive failure caused by project related disturbance, (2) increased public access and subsequent human disturbance resulting from new road construction, and (3) small, temporary reductions in prey populations.

The primary potential impact to raptors from project activities is disturbance during nesting that might result in reproductive failure. To minimize this potential, disturbance would not be allowed during the critical nesting season (Feb. 1 - July 31, depending on the species) near raptor nesting habitat. The size of the restrictive radius and the timing restriction may be modified depending on species of raptor and whether or not the nest is within the line of site to construction activities. Nests will be considered active if they were used within the past three years. No active raptor nests were located on the CRPA during 2003. If active raptor nests are located on the project area in future years, appropriate avoidance and mitigation measures would be taken to avoid impacts to breeding raptors.

4.7.1.1.6 Wild Horses

The Proposed Action is estimated to initially reduce available Animal Unit Months (AUMs) by about 45.6 AUMs which represents about 0.03% of the total 180,234 AUMs permitted for the Rock Springs grazing allotment (Lloyd 2003). During the estimated LOP, this total is estimated to decrease to about 15.4 AUMs which represents about 0.008% of the total permitted AUMs for the allotment.

Surface disturbing activities associated with the construction of well pads, reserve pits, and roads could adversely affect wild horses. Land clearing and grading activities necessary for construction remove vegetation (i.e., result in loss of forage resources) and create disturbance by increased human activity. BLM standards for reclamation of disturbed sites, such as linear road and pipeline ROWs and well pad sites are adequate to mitigate any potential adverse effect on wild horses due to vegetation removal. Effects of the Proposed Action would be temporary, as the vegetative conditions on most sites are ultimately reclaimed and return to pre-existing levels.

The short-term impacts of vegetation disturbance/removal on wild horses due to project activities is anticipated to be minor because the maximum initial disturbed area represents only 0.03 % of the total 1,913,364 areas within the Rock Springs gazing allotment As previously discussed, the estimated initial figure of 583 acres probably represents a maximum figure which would likely decrease, depending on the number and acreage of existing facilities and infrastructure that may be utilized by Anadarko during the course of the project. In addition, the fairly flat terrain of the CRPA may permit a number of drill pad sites to be leveled with minimal vegetation disturbance.

Because of increased vehicular activity, the Proposed Action has the potential to increase horse/vehicle collisions. However, if Anadarko advises project personnel regarding appropriate speed limits on designated access roads, the likelihood of horse/vehicle collisions would be minimized. The wary nature of wild horses and general avoidance of traveled roads also decreases their possibility of being struck by a vehicle.

Preventing and containing the spread of noxious and invasive plant species would be a positive impact to wild horses by reducing competition with native plants, consequently maximizing forage production.

Displacement of wild horses from the CRPA to areas outside the HMA boundary is estimated to be minimal due, in large part, to:

> (1) Long-term habituation of wild horses to existing oil and gas activities - The project area overlies an area already developed by two existing oil and gas projects including the Brady and Jackknife Spring Field's which have been in operation since 1972. Wild horses have experienced humans, vehicles, and oil/gas patch-related activities in this area of their habitat for more than 31 years;
>
> (2) Anadarko estimates that 2-4 years would be required to complete the project which provides a fairly wide-window of time for actual drilling activities, thus decreasing the potential concentration and number of drilling operations/vehicles/and people at any particular location, time or season;
>
> (3) By their nature, free-roaming wild horses in the Salt Wells HMA have shown the innate capacity to disperse over wide areas in search of food and water, seek shelter, or to escape insect pests and human activity and;
>
> (4) Transboundary movement of wild horses to adjoining HMAs is currently common between the shared, unfenced, border of the Adobe Town HMA and the Salt Wells HMA. As stated in Chapter 3, the AML for the Salt Wells HMA has never been achieved because of this unrestricted movement, the vast area of the two HMAs, and the existing selective removal criteria.

Because the CRPA is composed entirely of checkerboard lands, effective restrictions on wild horse population size exist as a result of several legal actions brought against the Department of Interior (DOI) by the Rock Springs Grazing Association (RSGA) beginning in 1979. In March 1981, the District Court ordered that the appropriate level for horse herds on the Salt Wells/Pilot Butte checkerboard lands, "is the level agreed to by the landowners and that all horses above such levels are excess within the meaning of the Act". (BLM-RSFO 1999a)

Primary public access to view wild horses in and near the project area is via U.S. Hwy 430, Sweetwater County Road's 4-24 and 4-26, and numerous access roads already present in the CRPA. The Proposed Action would not affect the opportunity for the public to view wild horses.

4.7.1.2 Alternative A - No Action

Under the No Action Alternative, the Proposed Action would not be implemented, however, the transport of natural gas products would be allowed from those wells in the CRPA that are currently in production. Direct and indirect impacts to wildlife would continue on federal lands as additional individual exploratory and development activities are considered by the BLM on a case-by-case basis. Impacts to wildlife would be similar to those described for the Proposed Action, but of a lesser magnitude.

Under the No Action Alternative, direct and indirect wild horse impacts could continue as additional exploratory and development activities beyond this EA are permitted by the BLM or allowed by private individuals and/or the RSGA. The impacts of project–related activity under the No Action Alternative are shown in Table 4-13. The No Action Alternative would initially reduce available AUMs to an estimated total of 32.4 AUMs (Proposed Action = 45.6 AUMs). The estimated total LOP AUM reduction is about 9.9 AUMs which represents about 0.005% of the total permitted AUMs for the Rock Springs grazing allotment.

4.7.2 Mitigation

No additional mitigation is required.

4.7.3 Residual Impacts

Although the potential impacts associated with the Proposed Action would be minor, the effects of some would persist until they were off-set over time. Such effects would include the: (1) long-term loss of 28.2 and 58.3 acres of crucial winter range for mule deer and pronghorn, respectively, and (2) long-term reduction of potential sage-grouse nesting habitat.

Construction of new roads may also cause long-term impacts such as increased human disturbance of wildlife near those roads and an increased potential for wildlife/vehicle collisions, poaching, and harassment.

Residual impacts to the wild horse resource are anticipated to be minor and short-term with implementation of and compliance with mitigation measures and stipulations stated in Chapter 2 of this EA, Anadarko's APDs, and the RMP.

4.8 SPECIAL STATUS WILDLIFE, FISH AND PLANT SPECIES

4.8.1 Threatened, Endangered or Proposed for Listing Species of Wildlife, Fish, and Plant

4.8.1.1 Fish

Formal consultation with the FWS for endangered fish species found in the Upper Colorado River System has been completed. Consultation concluded that since water depletions would average 10.11 acre-feet per year, or 40.46 acre-feet for the project, is below the threshold of 100 acre-feet criteria set for the recovery program, the depletion fee has been waived (August 29, 2003). No further direct, indirect, or cumulative impacts to endangered fish are anticipated.

4.8.2 Sensitive Wildlife, Fish, and Plant Species

Although these species have no legal protection under the ESA, the BLM and FWS still maintain an active interest in their numbers and status. All of these species may have the potential to occur on or near the project area and, therefore, potential impacts to them, that may be caused by the Proposed Action, are considered.

4.8.2.1 Proposed Action

4.8.2.1.1 Mammals

Swift Fox. Some portions of the project area may provide limited foraging habitat, however, swift foxes are very adaptable, and the limited amount of disturbance would not result in impacts to swift foxes, if they are present on the CRPA.

Wyoming Pocket Gopher. The Wyoming pocket gopher may be present in portions of the CRPA. This species utilizes dry ridge tops with dry gravelly soils and greasewood. This species may be abundant within its distribution, but no population studies have been conducted (Clark and Stromberg 1987). No impacts to this species are expected with development of the Proposed Action because habitat disturbance within the CRPA from development would be minimal.

Pygmy Rabbit. Pygmy rabbits are limited to areas of dense and tall big sagebrush (Campbell et al. 1982, Clark and Stromberg 1987, Heady et al. 2002). Although the project area is dominated primarily by Wyoming big sagebrush, and no pygmy rabbit occurrence has been reported within six miles (WGFD 2002c, WYNDD 2002), the possibility exists that pygmy rabbits occur in the CRPA. Approximately 568 acres of Wyoming big sagebrush habitat would be disturbed under the Proposed Action. This loss of pygmy rabbit habitat could result in the direct mortality of some individuals and displace others into surrounding areas of lesser quality habitat; however it is unlikely the population would be impacted because only 2.3% of the Wyoming big sagebrush habitat found within the project area would be disturbed. If pygmy rabbits are found to occur on the project area, potential impacts to them could be reduced by avoiding well, road, and pipeline placement within areas of tall dense sagebrush.

4.8.2.1.2 Birds

Mountain Plover. Although ideal mountain plover habitat does not occur in the project area, some areas of potential mountain plover habitat do occur, and these areas may provide limited nesting opportunities. No mountain plover sightings were reported in the WOS (WGFD 2002c) or the WYNDD (2002). No mountain plovers were observed in the potential habitat areas on the CRPA during surveys conducted in May and June 2003. A portion of the potential mountain plover habitat may be disturbed with implementation of the proposed action. Impacts to mountain plovers would be minimized by avoiding construction activities in suitable plover nesting habitat during the nesting period from April 10 -July 10, and/or avoiding surface disturbance within areas of potential mountain plover habitat the remainder of the year. The exact location of mountain plover nests may change annually, and mountain plover nest activity status and location must be kept current. For this reason, it is recommended that surveys for mountain plovers be conducted, within areas of potential habitat, prior to any surface disturbance in those areas, according to current mountain plover survey protocol (USDI-FWS

2002). No impacts to mountain plovers are expected provided that avoidance and mitigation measures outlined in this document and the RMP are implemented.

Sage Thrasher. The sage thrasher is considered a sagebrush obligate and is generally dependent on large patches and expanses of sagebrush steppe for successful breeding. Sage thrashers have been observed throughout Wyoming, including areas near the CRPA (WGFD 2002c). Development of the Proposed Action would likely displace some sage thrashers, however, suitable habitat is very abundant throughout the project area, and no impacts to this species are expected.

Loggerhead Shrike. Two records of loggerhead shrikes are documented within six miles of the CRPA. This species uses thickly foliaged trees and shrubs for nesting and roosting. Construction within this type of habitat may possibly disturb nesting shrikes. However, facilities associated with well development may provide increased perching sites, which shrikes use for hunting. Implementation of the Proposed Action is not likely to adversely affect the loggerhead shrike.

Brewer's Sparrow. The Brewer's sparrow breeds in landscapes dominated by big sagebrush (*Artemisia tridentata*) throughout the Great Basin and intermountain West (Rotenberry et al. 1999). Brewer's sparrows are likely present throughout the project area where suitable habitat occurs. Development of the Proposed Action would likely displace some Brewer's sparrows, however, suitable habitat is very abundant throughout the project area, and therefore, no impacts to this species are expected.

Sage Sparrow. Sage sparrows typically utilize stands of big sagebrush or mixed big sagebrush and greasewood for nesting. It is possible that the sage sparrow, a sagebrush-obligate species, may be present within the CRPA. Because of the small amount of disturbance associated with the project, their inherent mobility, and the availability of suitable habitats on undisturbed land, the impact to sage sparrows is expected to be minimal.

Burrowing Owl. Burrowing owls typically utilize areas located in active prairie dog towns where burrows are readily available (Butts 1973). Although white-tailed prairie dog colonies are present on the project area, burrowing owl sightings have not been reported on or within six miles of the project area. If nesting owls are found on the CRPA during future raptor nest surveys, the same measures used for other raptor species would be applied. Given these precautionary measures, no adverse impacts to burrowing owls are expected to result from the implementation of the Proposed Action.

4.8.2.1.3 Reptiles

Midget-faded Rattlesnake. In Wyoming, the midget-faded rattlesnake inhabits the lower Green River valley from the cities of Green River and Rock Springs south to the Utah-Wyoming state line. In southwestern Sweetwater County the midget faded rattlesnake is commonly found among rock outcroppings (Baxter and Stone 1992). The documented distribution of the midget-faded rattlesnake in Wyoming is south of the CRPA. However, the full extent of its range is not well known and the snake could potentially occur, although unlikely because of the lack of suitable habitat. Implementation of the Proposed Action is not expected to impact midget-faded rattlesnakes if present.

4.8.2.1.4 Amphibians

Great Basin Spadefoot Toad. Limited habitat exists in the area; however, it is possible that Great Basin spadefoots utilize the intermittent and temporary water sources for breeding during years with adequate moisture. If measures are taken to avoid disturbance of water sources, no adverse impacts to this species are expected from implementation of the Proposed Action.

4.8.2.1.5 Fish

The drainages in the project area are ephemeral or intermittent. Five fish species of special concern occur downstream of the CRPA: roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), and the leatherside chub (*Gila copei*, [BLM 2002]). Produced water would be disposed of in existing water disposal wells; therefore, project activities should not affect these fish species of concern found downstream from the CRPA.

4.8.2.2 Alternative A - No Action

Under the No Action Alternative, the Proposed Action would not be implemented, however, continued drilling on privately–owned lands would occur and transport of natural gas products would be allowed from those wells in the CRPA. Direct and indirect impacts to special status wildlife, fish, and plant species would continue as additional individual exploratory and development activities are considered by the BLM on a case-by-case basis. Impacts to special status wildlife, fish, and plant species resource would be similar to those described for the Proposed Action, but of a lesser magnitude.

4.8.2.3 Mitigation

To reduce potential impacts to pygmy rabbits, tall sagebrush (> 4ft) should be avoided where possible.

4.8.2.4 Residual Impacts

No adverse residual impacts are expected to occur with project implementation, assuming successful implementation of the proposed measures.

4.8.3 Migratory Birds

4.8.3.1 Proposed Action

Past and recent infill gas production and associated infrastructure activities have left the area with fragmented habitat. Reclamation to stabilize soil and reduce windborne dust has helped tie some of these fragmented habitats with an edge of mixed grasses. Some old stands of native vegetation will be lost over the short-term and eventually converted to early succession species. This will result in some species (mourning dove, etc) declining in nesting success, while other species (horned lark) will show increased nesting.

Water produced from shallow gas production is presently and in the future will be injected into deep saline formations. No adverse impacts to migratory birds are anticipated from the dewatering process. An increase in traffic could lead to bird collisions and road building will reduce available nesting.

4.8.3.2 No Action

Under the No Action Alternative, the Proposed Action would not be implemented, however, continued drilling on privately–owned lands would occur and transport of natural gas products would be allowed from producing wells in the CRPA. Direct and indirect impacts to migratory birds would continue as additional individual exploratory and development activities are considered by the BLM on a case-by-case basis.

4.8.3.3 Mitigation

No additional mitigation is required.

4.8.3.4 Residual Impacts

No adverse residual impacts are expected to occur with project implementation, assuming successful implementation of the proposed measures.

4.9 RECREATION

4.9.1 Impacts

4.9.1.1 Proposed Action

The CRPA includes two existing oilfields. Recreation use in the CRPA and immediately adjacent areas is believed to be minimal, at least in part because of the level of oil and gas development in the area and the availability of less developed areas in southern Sweetwater County. Few, if any, recreation users would be displaced by drilling and field development activities. Consequently, impacts to the recreation resource would be minimal due to the short-term nature of drilling and construction activities and small number of recreation users affected.

4.9.1.2 No Action

Under the No-Action alternative up to 48 wells could be drilled including 46 on private surface and 2 on state lands, or about 54 percent of the wells associated with the Proposed Action. Wells on public lands could potentially be drilled on a case by case basis. As with the Proposed Action, recreation impacts would be short-term and few recreation users would likely be affected. Therefore, only minimal impacts to recreation resources would be expected under the No Action alternative.

4.9.2 Mitigation

Given the minimal level of recreation impacts anticipated, no additional recreation mitigation measures are proposed beyond those identified in Chapter 2.

4.9.3 Residual Impacts

No residual recreation impacts are anticipated.

4.10 VISUAL RESOURCES

4.10.1 Impacts

4.10.1.1 Proposed Action

The Proposed Action would result in an intensification of the existing visual character within the CRPA, and long-term impacts associated with new resource roads and reclaimed well pads would be anticipated. Given the operator-proposed mitigation measures, these impacts would be within the guidelines for VRM Class IV areas. Reclamation of existing shortcut roads and other unnecessary disturbance would help the BLM meet its objectives for the VRM Rehabilitation area.

Impacts to visual resources associated with construction and drilling in the CRPA would include contrasts in line, form, color, and texture. In the short term (two to four years), these contrasts would be associated with surface disturbance, drilling rigs, construction equipment, service trailers and the general industrial character of drilling activities. Additional impacts could occur from fugitive dust produced by construction activities. In the longer term, contrasts would be associated with well facilities, access roads and ancillary facilities.
Potential reviewers of these contrasts would primarily be oil and gas field workers, grazing operators and recreation users passing through the area. Activity in the CRPA would not be visible from WYO 430.

In the BLM's VRM rating system, the severity of impact is related to the scenic quality, sensitivity level, and distance zone of the affected environment. The portion of the Proposed Action that would occur within the existing Brady and Jacknife Spring fields would result in an intensification of the existing character of the landscape. In the areas of the CRPA that have been previously undisturbed, the level of contrast would be somewhat higher but still visible to relatively few viewers. New disturbance, well pads and ancillary facilities located within view of county roads in these previously undisturbed areas would comprise the highest level of contrast. Visual effects would be most evident during the two to four-year drilling and field development phase of the project, when drilling rigs and construction equipment would be commonly seen, and disturbance for well pads and linear facilities would be relatively fresh. As drilling and field development is completed and disturbed areas are reclaimed, visual impacts would become less evident.

Given the operator-committed mitigation and reclamation measures described Chapter 2, the activities associated with the Proposed Action would be within VRM Class IV guidelines.

Portions of the CRPA are located within a VRM rehabilitation area, which was designated by the BLM due to a number of un-reclaimed shortcut roads and other unnecessary disturbance in the area. The reclamation objective is to improve the visual quality of the Rehabilitation area to that of the surrounding VRM classification, in this case, VRM Class IV. As part of its transportation planning process, Anadarko has committed to closure and reclamation of unnecessary roads and other disturbances, which would help achieve the BLM’s objectives in this VRM rehabilitation area (Deakins 2002).

4.10.1.2 No Action

Under the No Action alternative, up to 48 wells could be drilled on private and state lands. Additional wells could be drilled on federal lands on a case by case basis. Therefore visual impacts similar in nature to the Proposed Action could occur under the No Action alternative, although at diminished levels. The effects on the visual resource would be dependent on the level of development on private and state lands, the number of individually approved wells and ancillary facilities on public lands, the location of wells and ancillary facilities and the private and state requirements for visual impact mitigation.

4.10.2 Mitigation

Reclamation of old shortcut roads would reduce existing visual impacts.

4.10.3 Residual Impacts

Even after application of proposed measures, wellhead facilities, ancillary facilities and access roads would be visible for the life of the project, but these facilities would be within the guidelines for VRM Class IV areas.

4.11 CULTURAL RESOURCES

4.11.1 Impacts

4.11.1.1 The Proposed Action

The CRPA data base contains 70 sites in a 24,953 acre area. Sites include prehistoric open camps consisting of habitation sites and features. The prehistoric lithic debris sites are categorized as lithic scatters and secondary procurement sites.

The historic sites include ranching/stock herding sites, local transportation roads, and debris scatters. Prehistoric/historic sites are grouped into prehistoric camps with ranching activities and/or historic debris. Of the recorded cultural resources, 31.5% are recommended eligible for nomination to the NRHP, 31.5% are recommended not eligible for nomination to the NRHP, 36% remain unevaluated to the National Register, and 1% has been destroyed.

Potential impacts to specific eligible or unevaluated properties are unknown at this time. Portions of the study area are contained within the developed Brady and Jackknife Spring Fields. These fields were developed as early as 1972. Access to the field would be via U. S. Highway 430 , Sweetwater County Road 4-26, and existing improved roads. Projects (n=134) conducted in the Copper Ridge study area encompasses 38.989 square miles or 24,953.01 acres. Approximately 3619 ac (block) or ca. 14.5% of the analysis area have been inventoried at Class III or Class II level. The overall site density within the study area varies with the highest number of sites located along drainages. Black Buttes Creek and Sand Wash and their ephemeral drainages contain many of the known sites in the study area as do the juniper covered ridge tops. Certain topographic settings have a higher archaeological sensitivity such as eolian deposits (sand dunes, sand shadows, and sand sheets), alluvial deposits along major drainages, and colluvial deposits along lower slopes of ridges.

Adverse effects could be in the form of direct, indirect, or cumulative impacts. Direct impacts would primarily result from construction related activities and would be considered serious if lost information impeded efforts to reconstruct the prehistory or history of the region. Activities considered to have the greatest effect on cultural resources include blading of well pads and associated facilities, and the construction of roads and pipelines. Sites located outside the APE would not be directly affected by the construction activities. If the area of the site crossed by earth disturbing activities does not possess the qualities that contribute to the eligibility of the site, the project is judged to have no effect. Mitigation is the response for those sites that fall within the APE resulting in the loss of important information. Alteration of the environmental setting of eligible historic properties may be considered an adverse effect in the form of a direct impact.

Indirect impacts would not immediately result in the physical alteration of the property. Indirect impacts to prehistoric sites primarily would result from unauthorized surface collecting of artifacts which could physically alter the sites. At historic sites this could include bottle collecting and the introduction of visual impacts.

4.11.1.2 No Action Alternative

Under the No Action alternative drilling and field development could occur on private lands and possibly on public lands on a case by case basis. Consequently, impacts to cultural resources similar in nature to the Proposed Action could occur under the No Action alternative, although at diminished levels.

4.11.2 Mitigation

No additional mitigation measures are necessary.

4.11.3 Residual impacts

Avoidance of known important cultural resources during construction projects and implementation of Class III cultural resource inventories for the proposed actions minimizes the potential for adverse impacts to cultural resources. However, despite all of the proposed measures for protection of cultural resources, the potential exists that these resources could accidentally be damaged if not identified prior to construction activities.

4.12 SOCIOECONOMICS

4.12.1 Impacts

4.12.1.1 Proposed Action

Socioeconomic effects of the Proposed Action would be largely positive. The project would enhance regional economic conditions and generate local, state and federal government tax and royalty revenues. The relatively small, short-term drilling and field development workforce would generate minimal demand for temporary housing or local government services. Consequently no substantial negative socioeconomic impacts are anticipated.

Economic and Employment Effects

Development and operation of the Proposed Action would require goods and services from a variety of local and regional contractors and vendors, from the oil and gas service industry and from other industries. Expenditures by the proponent for these goods and services, coupled with employee and contractor spending, would generate both direct and indirect economic effects in southwest Wyoming, elsewhere in the State of Wyoming and in the nation as a whole.

For the Proposed Action, direct drilling and field development employment was estimated by assuming a two-year drilling and field development schedule, and by simulating a drilling season, using the per-well employment estimates displayed in Table 2-2. Based on this simulation, drilling and field development employment associated with the proposed action would require between 20,000 and 21,000 worker days annually over the two year period, which equals about 80 full-time job equivalents.

Drilling and field development employment would average just under 100 workers per day during the eight month annual drilling period, with peak days of as much as 150 workers. Development of central compression facilities would require an additional 15 to 20 workers for a 45-day period.

Most drilling and field development work would be performed by contractors who would be on site for the duration of their task. In some cases, such as drilling contractors, these workers would work in the CRPA for months at a time, in other cases, workers would be on site for a matter of days or hours.

During project operations, some tasks would be performed by existing Brady Field employees and an average of 2 additional fulltime employees would be required. Each well would require workover operations every 1.5 years, during which time a crew of 4 or 5 workers would work at the well for a variable number of days, depending on the workover activities required at each well.

The Proposed Action as described in Chapter 2 of this assessment would involve an estimated $56 million capital investment in natural gas wells. A recent study prepared by the University of Wyoming Agricultural Economics Department (USBLM 2003), estimated employment, earnings and total economic impact associated with natural gas drilling and completion in the Jack Morrow Hills area, a portion of which is also in Sweetwater County. The study estimated that a drilled and completed coal bed methane well of less than 1,200 feet in depth would require $143,000 in direct expenditures and would generate $194,000 in total economic impact, $29,600 in total earnings and about one full-time equivalent job (all estimates are in inflation-adjusted 2001 dollars).

The study also estimated that a gas well drilled and completed to an average 9,000 feet would result in $620,784 in direct expenditures and would generate $847,000 in total economic impact, including $131,000 in earnings and 2.12 full time equivalent jobs.

The 89 wells associated with the Proposed Action are anticipated to range between 2,000 and 4,500 feet in depth. However, Anadarko estimates that each well would cost $620,000 to drill and complete, which indicates that the wells in the Copper Ridge area would have economic effects similar to the conventional wells in the Jack Morrow Hills area. Using the estimates for conventional gas wells contained in the UW study, the drilling phase of the Proposed Action would generate an estimated $75 million in total economic impact, $11 million in total earnings and over 180 full-time equivalent jobs (direct and indirect).

The UW study also estimated the economic effects associated with 1,000 MCF of natural gas produced in southwest Wyoming at an average sales price of $2.81/MCF ($2001). These estimates included $2,793 in total economic impact in southwest Wyoming, $188 in earnings and .005387 jobs.

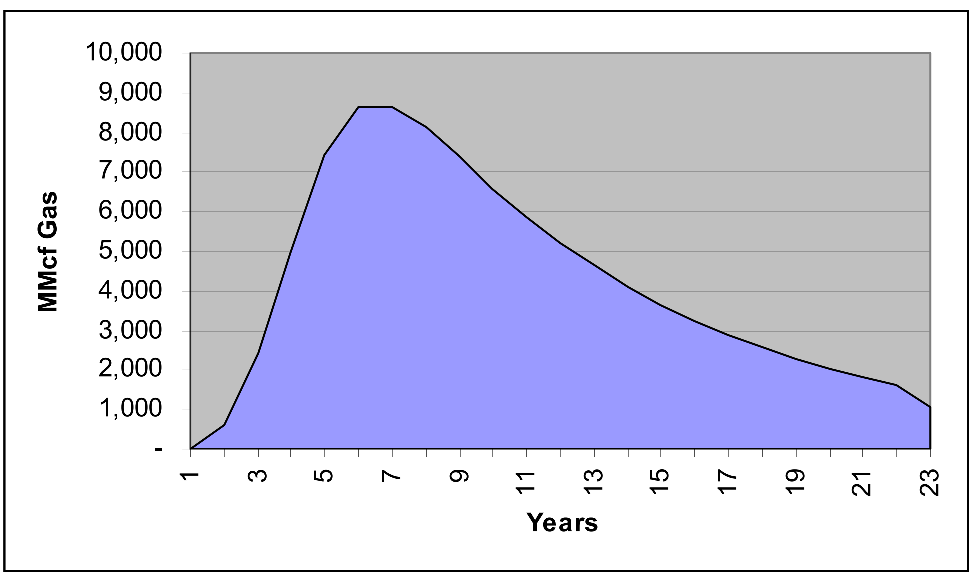
Anadarko anticipates that the 89 wells associated with the Proposed Action would produce an estimated 95.7 MMscf over 22 years. Based on the UW estimates, the 89 wells associated with the Proposed Action would generate an estimated total of $267 million in total economic impact in southwest Wyoming over 22 years, or an average annual economic impact of $12.1 million. This would include estimated total earnings of $18 million (an annual average of $818,000), associated with an annual average of 23 full-time equivalent direct and indirect jobs.

The foregoing assessment assumes that all wells would be successful. If some wells were dry, if production were less than anticipated, or if gas prices were lower than the EIA forecasts, the economic effects of the project would be lower than those presented above. Conversely, higher rates of production and/or gas sales prices would produce higher economic effects.

Sweetwater County Oil and Gas Activity

Successful completion of the Proposed Action would modestly increase natural gas production in Sweetwater County. Based on operator production forecasts, peak year Copper Ridge production (8,657 MMscf) would be about 4 percent of total 2001 Sweetwater County natural gas production.

Figure 4-2. Estimated Annual Proposed Action-Related Natural Gas Production



Sources: Anadarko, Blankenship Consulting LLC

Assuming that the 89 wells associated with the Proposed Action were drilled in two years, the annual increment in drilling would be about eight percent of all Sweetwater County APD's approved in 2001.

Population Effects

Direct and indirect population effects of the Proposed Action would be minimal. Drilling and field development activities associated with the Proposed Action would be performed by contractors, who may come from Rock Springs, from elsewhere in Wyoming or from out of state. Non-local contractors and their employees would be likely to locate to Sweetwater County temporarily, for the duration of their contract. Given the short-term nature of the drilling and field development phase of the project, non-local workers are likely to relocate to Sweetwater County single status, and return to their place of residence on their days-off and during periods when drilling ceases.

The relatively few direct jobs associated with project operations would not generate measurable population effects. The indirect jobs are likely to be filled by existing residents.

The economic activity associated with the Proposed Action would result in increased employment opportunities in other sectors of the economy, however, these indirect jobs are likely to be filled by existing residents rather than non-local workers. Consequently, the net effect of the Proposed Action may be to minimally slow population decline in Sweetwater County.

The preceding conclusions assume an overall level of regional oil and gas development similar to that of recent years. Section 4.12.5 discusses potential cumulative impacts associated with elevated levels of development.

Housing Demand

Non-local drilling and field development workers associated with the Proposed Action would be likely to seek temporary housing resources in the Rock Springs area. Existing temporary housing resources in Rock Springs could accommodate the relatively small Proposed Action-related demand for temporary housing. The operations phase of the Proposed Action would not generate appreciable housing demand.

Community Facilities, Law Enforcement and Emergency Response Demand

Most community infrastructure in Sweetwater County and Rock Springs has been sized to serve a larger population than currently exists. Therefore, the relatively small temporary population increases associated with the Proposed Action would be accommodated with existing county and municipal facilities. Emergency services demand associated with field development and operations activities would also be accommodated by existing Sweetwater County law enforcement and emergency management resources (Scofield 2003, Valentine 2003).

Fiscal Effects

The Proposed Action would generate certain state and local tax revenues including:

- local ad valorem property taxes on production and certain field facilities;

- sales and uses taxes to the State of Wyoming, Sweetwater County and its incorporated municipalities;
- mineral royalties to the federal government, a portion of which are returned to the State and local governments; and,
- state severance taxes.

The Proposed Action would generate ad valorem property tax revenue to Sweetwater County, the Wyoming School Foundation Fund, Sweetwater County Schools and various taxing districts within the county. Ad valorem taxes would be generated from two sources: 1) the fair market value of methane produced and sold; and 2) the value of certain capital facilities within the well fields (all underground facilities associated with wells are exempt by State statute).

Constant 2003 Sweetwater County mill levies were used to prepare the following estimates. In reality some mill levies are set each year by the Sweetwater County Commissioners, officials of the various special and school districts and the state; some change each year. Mill levies reflect the revenue needs of the taxing entity and estimates of assessed valuation within the entity.

Based on Anadarko production estimates, US DOE Energy Information Administration price forecasts for natural gas (USDOE EIA 2003), and FY 2003 mill levies, the estimated Proposed Action-related gas production would generate $18.7 million (2001$) in ad valorem property taxes to all entities, or an average of $851,000 year. Note that peak production is not reached until several years after wells come on line, so early production years would yield lower revenues. Of the total property tax revenues, about 70 percent would be distributed to State and local schools and only about 17 percent would be distributed to Sweetwater County government.

A total of 41 of the 89 wells associated with the Proposed Action are anticipated to be on federal lands. The federal government collects a 12.5 percent royalty on the fair market value of gas produced from federal leases, less production and transportation costs. Half of mineral royalty revenues are returned to the state where the minerals were produced. In Wyoming, a portion of the state's share is distributed to local governments and to the Wyoming School Foundation Fund.

Based on Anadarko production estimates and USDOE EIA price forecasts for natural gas, an estimated total $13 million (2001$) in Federal Mineral Royalties would be generated by the Proposed Action; and approximately $6.5 million of that amount would be returned to the State of Wyoming. Actual Mineral Royalty revenues collected would vary based on actual production levels, gas sales prices, and production and transportation costs.

The State of Wyoming collects a six- percent severance tax on the fair market value of natural gas produced within the state. Federal mineral royalty payments and production and transportation costs are exempt from this tax. The state uses revenues from this fund for a variety of purposes (e.g., General Fund, Water Development Fund, Mineral Trust Fund, and Budget Reserve) and returns a portion to counties and municipalities.

An estimated total $12.8 million ($2001) in severance taxes would be generated by the Proposed Action. Actual severance tax revenues would vary based on actual production levels, gas sales prices, and production and transportation costs.

Wyoming levies a four percent sales and use tax on the gross receipts of tangible goods and certain services (drilling services are exempted). The state returns 28 percent of the revenue (less administrative costs) to the county and municipalities where the taxes were collected. Sweetwater County also levies a one-percent local option sales and use tax, which is distributed to the county and its municipalities and a 0.5 percent facilities tax. Proceeds from the facilities tax would be used to fund construction of a new county jail.

In drilling the 89 wells associated with the Proposed Action, an estimated $28 million would be spent for goods and services subject to state and local sales and use taxes. This amount would generate about $1.5 million in total sales and use tax revenues, including $800,000 for the State of Wyoming and about $ 590,000 for Sweetwater County and its municipalities. The local option facilities tax would raise an estimated $140,000 from Proposed Action-related expenditures.

4.12.1.2 No Action

Under the No-Action alternative up to 48 wells could be drilled including 46 on private surface and 2 on state lands, which amounts to 54 percent of the wells associated with the Proposed Action. Consequently, using the same assumptions and methods as for the Proposed Action, the effects of the No Action would be similar in nature to those described for the Proposed Action, but at about half (54 percent) of the magnitude.

As with the Proposed Action, population effects of the No Action alternative would be minimal and result in little incremental demand for housing or for local government services.

Based on the same assumptions as the Proposed Action, direct employment associated with the No Action alternative could total about 11,000 worker days over a two-year field development period, or about 42 direct full-time job equivalents, assuming all 48 wells were drilled.

Using the multipliers obtained from the UW study, the drilling phase would generate about $41 million in total economic impact in southwestern Wyoming, including $6 million in earnings associated with 97 full-time equivalent jobs (direct and indirect). Under the No Action alternative, gas produced from the Copper Ridge field would generate an estimated $144 million in total economic impact in southwest Wyoming over the 22 year life of the field, including $10 million in wages associated with an annual average of 12 jobs.

Under the No Action alternative, production-related ad valorem taxes to all entities would total about $10.1 million over the life of the field. State severance taxes would yield about $7 million. There would be no federal mineral royalties associated with the No Action alternative. The drilling program would generate an estimated $810,000 in sales and use tax including about $432,000 for the state of Wyoming and $236,000 for Sweetwater County and its municipalities. The local option facilities tax would raise about $76,000.

4.12.2 Mitigation

No substantial negative socioeconomic impacts are anticipated to be associated with the either alternative. Anadarko should coordinate emergency response planning with the Sweetwater County Emergency Management Agency. The property and sales and use taxes associated with the Proposed Action would provide revenues to local governments in Sweetwater County to compensate for the anticipated minimal Proposed Action-related demand for law enforcement and emergency response services. However, there would be a lag between the time development begins and the time substantial project-related tax revenues flow to the county.

4.12.3 Residual Impacts

No residual socioeconomic impacts are anticipated.

4.13 TRANSPORTATION

4.13.1 Impacts

4.13.1.1 Proposed Action

Transportation effects of the Proposed Action would occur primarily on WYO 430, SCR 4-26 and SCR 4-24. These public roads provide access to the CRPA from Rock Springs, where the majority of project related traffic would originate. Secondary transportation effects could occur on I-80, SCR 4-19 and SCR 4-84, although use of the latter routes for project access is anticipated to be minimal. Transportation impacts would also occur on operator-maintained roads within the CRPA. The increases in traffic associated with the Proposed Action could accelerate road maintenance requirements and generate short-term increased risk of accidents on state highways and county roads, but successful implementation of mitigation measures would help avoid these impacts.

The Proposed Action would primarily generate increases in traffic volumes on WYO 430, SCR 4-24 and SCR 4-26. These increases would result from the movement of project-related workers, equipment and materials to and from the project area to perform drilling, field development, well service, field operations and reclamation activities.

The largest increase in project-related traffic would occur during drilling and field development. Drilling of each well would generate an estimated 451 one-way trips, or an average of 11 trips per day over the 41 day drilling and completion cycle, and the peak daily traffic could be as high as 25 trips. Field development activities such as production testing, construction of gas gathering, water disposal, electrical power distribution and wellhead compression systems would raise average daily per well traffic to 13 trips, with peak days as high as 43 trips.

The Proposed Action anticipates drilling 89 wells in two to four years. For the transportation assessment, a two-year drilling period was assumed. It is also assumed that wildlife and seasonal stipulations would reduce the drilling period to 212 days in any given year. Based on these assumptions and a four-rig drilling and field development simulation, an estimated annual 19,760 one-way trips (9,880 round trips) would be generated by the Proposed Action during drilling and field development. This is an average daily traffic (ADT) of 93 one-way trips (46.5 round trips) per day over the 212-day drilling cycle, or an average annual daily traffic (AADT) increase of 54 trips on affected highways and roads. On peak days, traffic could reach 152 one-way trips (76 round trips). It is estimated that about 40 percent of all trips would involve trucks larger than 2½ tons. Note that these estimates reflect a two-year drilling schedule; if drilling and field development extends to three or four years, the annual number of trips would be reduced accordingly.

During project operations and reclamation, some trips would be combined with trips to serve existing Brady Filed wells and ancillary facilities. Incremental one- way trips would average less than 10 per day, except during well workovers, which might average 10 to 20 one-way trips/day for several days depending on the operations that would be performed.

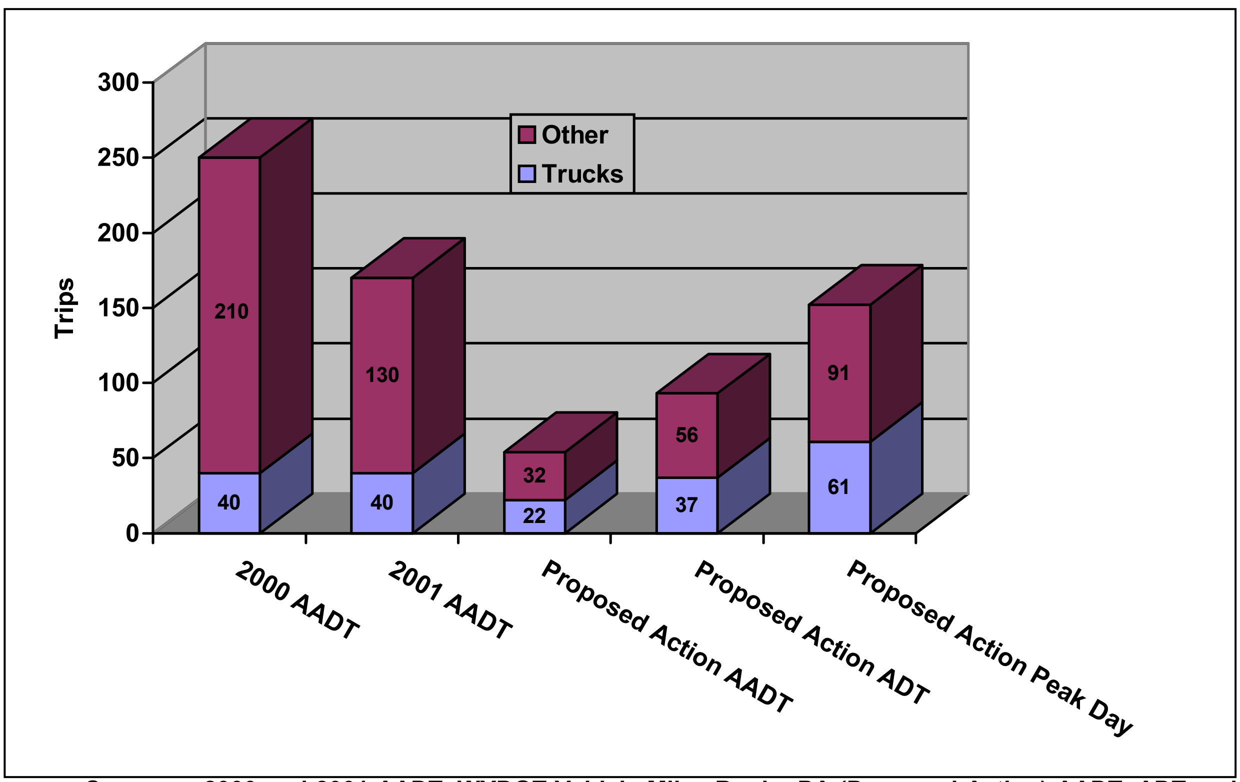
State Highways

Figure 4-3 contrasts estimated Proposed Action-related traffic estimates with recent Wyoming Department of Transportation AADT counts on WYO 430, at the turn-off to SCR 4-26. Estimated project- related traffic would be about 32 percent of 2001 AADT on WYO 430.

However, the Proposed Action AADT and 2001 AADT combined would still be less than 2000 levels for all traffic. Average-annual daily truck traffic would be 54 percent of both 2000 and 2001 levels.

Average daily traffic (ADT) during the 212-day drilling period would be about 55 percent of 2000 AADT. Truck traffic during that period would be about 93 percent higher than average annual daily truck traffic in both 2000 and 2001. Peak day traffic associated with the Proposed Action would be about 89 percent of 2001 AADT and 61 percent of 2000 AADT. Truck traffic on the peak day would be about 150 percent of average annual truck traffic during those years.

Figure 4-3. Proposed Action-Related Traffic on WYO 430 compared to 2001 and 2002 AADT



Sources: 2000 and 2001 AADT, WYDOT Vehicle Miles Book. PA (Proposed Action) AADT, ADT and Peak Day traffic, Blankenship Consulting LLC.

While WYO 430 could accommodate the estimated traffic volumes associated with the Proposed Action, overweight trucks would accelerate maintenance requirements on the highway and oversize trucks would pose safety concerns on this relatively narrow highway with narrow shoulders and steep side slopes, particularly during wet or icy conditions.

Additionally, the existing safety concerns associated with the approach to the SCR 4-26 turnoff from WYO 430 would be exacerbated by the additional heavy truck traffic. Similarly, the existing problem of trucks depositing gravel on WYO 430 as they exit SCR 4-26 would be exacerbated (Monturro 2003).

<u>County Roads</u>

The Proposed Action would result in substantial increases in traffic on the county roads that provide primary access to the CRPA (SCR 4-24 and 4-26) during the drilling and field development period. This increase in traffic, particularly heavy truck traffic, would accelerate deterioration of county roads. Excessive speed or use of the roads when they are muddy could damage the road surface. Deteriorated roads would result in accelerated road maintenance requirements for the Sweetwater County Road and Bridge Department and potential inconvenience and safety hazards for all road users. The Proposed Action-related increase in traffic would also exacerbate existing dust problems on SCR 4-24 (Gibbons 2003). The cost associated with accelerated road maintenance requirements and dust control on county roads may be offset by the Proposed Action-related ad valorem and sales and use tax revenues generated to county government. However, the availability of substantial project-related revenues would lag county road maintenance requirements by several years.

<u>Internal Roads</u>

Section 2.2.2.1 (Road Construction) describes the measure proposed by the proponent to develop the transportation network necessary to access wells and ancillary facilities within the CRPA. According to the proponent, existing resource roads within the Brady and Jacknife Spring fields would be used to the extent feasible. Anadarko anticipates constructing or reconstructing an estimated 22.5 miles of resource roads to access new well locations. Anadarko would also be responsible for maintaining existing and new roads within the project area. New resource road locations would be identified in consultation with the BLM RO and be designed, constructed and maintained in compliance with the standards contained in BLM Manual 9113.

Some roads to well locations would be looped to provide additional egress options in compliance with the Brady Plant H^2S safety plan. Locations for loop roads would be identified in consultation with the BLM RO and road routes would be designed to consider slope, soils, vegetation and other sensitive resource issues.

4.13.1.2 No Action Alternative

Implementation of the No-Action alternative may result in increased traffic on State, county and resource roads because gas leases could be developed on private lands and potentially approved for BLM lands on a case by case basis. Transportation impacts similar to those described under the Proposed Action could occur, but at a reduced level. Based on the potential that a total of 48 wells could be developed on private and state lands, and the simulation used for the Proposed Action, an estimated 11,600 one-way trips (5,800 round-trips) would be generated during each year of field development. This is an ADT of 55 trips during the 212-day drilling cycle or an AADT of 32, about 19 percent of 2001 AADT on WYO 430 at the turn-off to SCR 4-26. A projected 83 trips would occur on the peak day.

4.13.2 Mitigation

The following measures should further reduce potential impacts.

Mitigation for impacts on State highways would include:

- Coordination with WYODOT and the Sweetwater Road and Bridge Department to ensure that the approach to the SCR 4-16 turnoff from WYO 430 is adequate to handle tractor trailer combinations.
- Coordination with WYODOT and the Sweetwater Road and Bridge Department to ensure that the approach from SCR 4-26 to WYO 430 is paved or otherwise treated to allow trucks to shed gravel before entering the highway.

Mitigation for County Roads would include:

- Anadarko and contractor policies to reinforce speed limits and other traffic safety laws on SCR 4-26 and 4-24, and on operator-maintained roads within the CRPA.
- Assistance to the Sweetwater Road and Bridge Department in obtaining gravel, water and dust suppressant for application on SCR 4-26 and 4-24.

4.13.3 Residual Impacts

Minor increases in traffic associated with production, well and pipeline service and reclamation activities would continue throughout the life of the project.

4.14 HEALTH AND SAFETY

4.14.1 Impacts

4.14.1.2 Proposed Action

Potential health and safety effects associated with the Proposed Action would be similar in nature to those associated with existing conditions in the CRPA, but would occur at increased levels, especially during the drilling and field development phase of the project. Potential health and safety effects include hazards associated with natural gas development and operations; risk associated with vehicular travel on county, BLM and operator-maintained roads; firearms accidents during hunting season and by casual firearms use such as plinking and target shooting; and natural events such as range fires.

Health and safety impacts of the Proposed would include a relatively low risk to project workers from industrial accidents, firearm accidents and natural disasters. There would be a slight increase in risk of traffic accidents and range fires for the general public during drilling and field development and a negligible increase during field operations.

Occupational Hazards

The US BLM, OSHA, USDOT and Wyoming OGCC each regulate certain safety aspects of oil and gas development. Adherence to relevant safety regulations on the part of the operator and enforcement by the respective agencies would reduce the probability of accidents. Additionally, given the remote nature of the project area, and the relatively low use of these lands by others (primarily grazing permittees), occupational hazards associated with the Proposed Action would mainly be limited to employees and contractors rather than the public at large.

Pipeline Hazards

Increasing the miles of gathering and transmission pipelines within the CRPA would increase the chance of a pipeline failure. However, the relatively small amount of new pipeline associated with the Proposed Action, coupled with the low probability of failure and the remoteness of the project area would result in minimal risk to public health and safety. Signing of pipeline rights-of-way could reduce the likelihood of pipeline ruptures caused by excavation equipment - particularly in the vicinity of road crossings or areas likely to be disturbed by road maintenance activities.

Hazardous Materials

Drilling, field development and production activities require use of a variety of chemicals and other materials, some of which would be classified as hazardous. Potential impacts associated with hazardous materials include human contact, inhalation or ingestion and the effects of exposure, spills or accidental fires on soils, surface and ground water resources and wildlife.

The risk of human contact would be limited predominately to CRPA operator and contractor employees. A Hazard Communication Program, Spill Prevention Control and Countermeasure (SPCC) Plans, and other mitigation measures described in Section 2.2.2.12.7 would reduce the risk of human contact, spills and accidental fires, and provide protocols and employee training to deal with these events should they occur.

H_2S

Although natural gas produced from the Almond formation would not contain H_2S, the existing Brady Plant, which is located in the CRPA, recovers sour gas which is subsequently reinjected to maintain pressure in the deeper Weber and Nugget formations in the Brady field. Copper Ridge project workers would be subject to risks associated with operating in a potential H_2S release area. The Plant is authorized under WDEQ Permit 31-023, and is covered by H_2S Contingency Plans.

Other Risks and Hazards

Highway and road safety impacts are discussed in Section 4.12 (Transportation). Sanitation and hazardous material impacts would be avoided or reduced by the implementation of the mitigation measures outlined in Section 2.2.212.7.

The potential for firearms-related accidents would occur primarily during hunting season. The CRPA is believed to receive minimal hunting use and the increased activity during drilling and field development would be likely to further discourage hunting in the CRPA. Consequently the risk of fire arms-related accidents should be minimal. During project operations, the relatively few personnel on site would also result in minimal risk of firearms-related accidents.

The risk of fire in the analysis area would increase under the Proposed Action. This is an unavoidable impact associated with construction activities, industrial development and the presence of fuels, storage tanks, natural gas pipelines and gas production equipment. However, this risk would be reduced by the placement of facilities on pads and locations that are graded and devoid of vegetation, which could lead, to wildfires. In the event of a fire, property damage most likely would be limited to construction or production-related equipment and range resources. Fire suppression equipment, a no smoking policy, shutdown devices and other safety measures typically incorporated into gas drilling and production activities would help to minimize the risk of fire. There would be a heightened risk of wildfire where construction activities place welding and other equipment in close proximity to native vegetation. Given the limited public use and presence in the project area, the risk to the public would be minimal. There would be a small in increase in risk to area fire suppression personal associated with the Proposed Action.

Based on the foregoing assessment, risks to public health and safety should not substantially increase as a result of the Proposed Action.

4.14.1.2 No Action

The health and safety risks identified under the Proposed Action could also occur under the No Action alternative, given that up to 48 wells could be developed on private and state land and on public land on a case by case basis. The magnitude of risk would be dependent on the level of development that would occur, but is likely to be less than that associated with the Proposed Action. Operators would be subject to the same health and safety standards and regulations as under the Proposed Action, therefore, substantial risks to public health and safety would not be anticipated under the No Action alternative.

4.14.2 Mitigation

Application of the following measures should further reduce potential impacts.

- The Brady Plant H_2S Contingency Plan should be reviewed to ensure that contingency procedures effectively address the planned drilling and field development activities.
- Anadarko should coordinate emergency response planning with the Sweetwater County Emergency Management Agency and provide documentation regarding compliance with Federal Hazardous Material Regulations and the Uniform Fire Code.

4.14.3 Residual Impacts

Risk to health and safety of workers, contractors and other users of the project area associated with industrial accidents, H_2S releases, transportation accidents, shooting accidents and natural disasters would remain for the life of the project. However, these risks would be small, given the remoteness of the area, the few employees and visitors anticipated and the proposed mitigation measures.

4-15. NOISE

4.15.1 Impacts

4.15.1.1 Proposed Action

Noise impacts on wildlife resources are addressed in Section 4.7. Noise levels associated with drilling, field development and operations activities may temporarily exceed 55 dBA, but the lack of human residences and the low level of non project-related human occupation of the project area would result in minimal noise impacts. Although noise impacts associated with compression facilities would be long term in duration, these same factors; lack of human residences and low human densities, would result in minimal compression noise impacts.

Implementation of the Proposed Action has the potential to create noise-generated impacts that emanate from machinery used during drilling and during construction of drill sites, pipelines, access roads and ancillary facilities, and from the operation of heavy trucks and related equipment. During field operations, noise would be generated by compression facilities, pumper trucks, road maintenance equipment and by well workover operations.

Noise associated with natural gas drilling, field development and field operations can affect human safety (at extreme levels) and comfort. Noise impacts can also modify animal behavior (see Section 4.7 for a discussion of the potential noise impacts to wildlife resources). The magnitude of noise impacts are contingent on a number of factors including the intensity and pitch of the source, air density, humidity, wind direction, screening/focusing by topography or vegetation, and distance to the observer. A variety of heavy equipment and machinery commonly used during drilling, field development and production operations generate noise levels in excess of the 55 dBA maximum standard. Noise impacts created by these activities are short term, lasting as long as drilling, construction or field maintenance activities are performed at well sites, access roads, pipelines, and ancillary facilities. Under typical conditions, noise levels decline below the 55 dBA maximum standard at a relatively short distance (less than one mile from the source) depending on the factors outlined above.

Drilling, field development and field operations workers would be the only groups directly affected by Proposed Action-related noise disturbances for more than a brief period of time. These groups are subject to OSHA regulations regarding industrial noise protection. Grazing operators and recreation users of the area are few in number and would typically be affected by noise impacts only for the brief period required to pass by sites where drilling, field development and field operations occur.

Natural gas compression facilities would be a source of long-term noise impacts. These impacts would exceed the 55 dBA maximum standard at the compression site, but noise levels would be attenuated to below acceptable levels at a distance of 0.25 miles from the compression site (see Section 2.2.2.12.3). There are no residences located with in the CRPA and compression facilities would be located on private land. Therefore, field operations workers would be the only group affected by compression noise for other than a brief period of time.

Based on the foregoing and the noise mitigation measures contained in Section 2.2.2.12.3, noise impacts associated with the Proposed Action would be minimal.

4.15.1.2 No Action

Up to 48 wells could be developed on private and state lands and additional wells could be approved on public lands on a case-by-case basis. Therefore, implementation of the No Action Alternative could result in noise impacts similar to those associated with the Proposed Action, but noise generating activities would likely occur at fewer locations on public land. As with the Proposed Action, the lack of human residences and the low level of non project-related human occupation of the project area would result in minimal noise impacts.

4.15.2 Mitigation

Measures to further mitigate potential noise impacts include the following:

- In any area of operations (drill site, compressor site, etc.) where noise levels may exceed federal OSHA safe limits, Anadarko and its contractors would provide and require the use of proper personnel protective equipment by employees.

4.15.3 Residual Impacts

Although both intermittent (field maintenance and workover activities) and long-term (compression facilities) exceedences of 55 dBA noise levels would occur for the life of the project, the lack of human residences and the low human occupation of the project area would result in negligible noise impacts.

4.16 UNAVOIDABLE ADVERSE IMPACTS

4.16.1 The Proposed Action

The Proposed Action would disturb approximately 583 acres, thus increasing the potential for wind and water erosion before the land is revegetated. Other unavoidable adverse impacts are a short-term loss of vegetation and forage production, the temporary loss of livestock forage, short-term turbidity and some sedimentation at local drainages, short-term impacts to air quality /noise levels due to construction activities, short-term loss of pronghorn yearlong winter range, and possible temporary disruption of wildlife activities during construction.

4.16.2 No Action Alternative

Under the No Action Alternative, there would be reduced beneficial economic impacts to local, regional, and national economies.

4.17 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT VS. LONG-TERM PRODUCTIVITY

4.17.1 The Proposed Action

Short-term use of the environment would facilitate and enhance natural gas production and stimulate local economies. Environmental impacts would be short-term and minimal. The proposed project would not adversely affect long-term use and would enhance long-term productivity related to natural gas supplies.

4.17.2 No Action Alternative

There would be no changes in short-term use under the No Action Alternative. Long-term productivity in terms of natural gas production would be reduced.

4.18 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

4.18.1 The Proposed Action

Irreversible or irretrievable commitments of resources would include the depletion of energy, materials, and manpower necessary to implement the Proposed Action.

4.18.2 No Action Alternative

There would be reduced resource commitments under the No Action Alternative.

CHAPTER 5

CUMULATIVE IMPACTS ANALYSIS

5.1 INTRODUCTION

NEPA requires an assessment of potential cumulative impacts. Federal regulations (40 CFR 1508.7) define cumulative impacts as:

> "...*the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time*."

Potential cumulative impacts are assessed at the resource level. The cumulative impact analysis (CIA) area for past, existing and reasonably foreseeable future activities (RFFA's) that may generate cumulative impacts varies depending on the resource under consideration. For example, the CIA area for air quality effects is regional in nature; therefore the scope of activities considered is necessarily broad. In contrast, the CIA area for geology and minerals considers the project area associated with the proposed action and alternatives; therefore the scope of potential cumulative activities considered is much narrower.

This discussion of potential cumulative impacts assumes the successful implementation of the environmental protection and mitigation measures discussed in chapters two and four of this EA as well as compliance with the GRRA RMP and all applicable federal, state and local regulations and permit requirements. The analysis of cumulative impacts addresses both potential negative and positive impacts.

5.2 PAST, EXISTING AND REASONABLY FORESEEABLE FUTURE ACTIVITY

Past, existing and RFFA s are organized by CIA area and include the following:

5.2.1 Copper Ridge Project Area

Historic and existing activities in the CRPA include cattle grazing, dispersed recreation and oil and gas exploration, development and production. Reasonably foreseeable future activities within the CRPA are limited to the Proposed Action and alternatives.

While future natural gas proposals are possible, the Proposed Action incorporates all reasonably foreseeable natural gas activity within the project area based on current knowledge of the area's geology and natural gas drilling and development technology. If these factors change and additional proposals are submitted, or major changes in the Proposed Action are warranted, additional NEPA assessment (including cumulative impact analysis) would be required.

5.2.1.1 Disturbance within the Copper Ridge Project Area

Existing disturbance within the CRPA is approximately 370 acres, or around 1.5 percent of the 24,953 acres comprising the project area. During the construction phase, the Proposed Action would disturb 583 acres. Under Alternative A (No-Action) disturbance would be 397 acres (Table 2-2). Disturbance areas within the CRPA area would be reduced upon reclamation of pipeline ROW's and unused portions of drill pad and ancillary facility disturbances during the production phase for each alternative. Under the Proposed Action, reclamation would reduce impacts to 171 acres for a cumulative impact of 541 acres or 2.2 percent of the CRPA. Alternative A impacts would decrease to 109 acres, with cumulative impacts affecting 479 acres or about 1.9 percent of the CRPA.

5.3 CUMULATIVE IMPACTS ANALYSIS

Table 5-1 details the cumulative impacts by resource area associated with the Copper Ridge Shallow Gas Project. Based on analysis of the cumulative effects for the identified areas by resource and considering that existing, proposed, and foreseeable actions would result in the disturbance of no more than 2.5% of any one area assessed, the proposed action would not result in considerable degradation to the resource.

5.3.1 Geology/Minerals/Paleontology

Existing, proposed, and reasonably foreseeable actions would not affect landslide deposits and would be unlikely to trigger geologic hazards such as landslides, mudslides, debris flows, or slumps, no incremental increase in cumulative impacts associated with geologic hazards would occur. If drilling policy is followed including proper well pad and facility siting, construction, and reclamation techniques, the cumulative impacts to the surface geologic environment would be minimized. Proposed and RFFA's would require the restoration of disturbed lands to predisturbance conditions and as such would minimize topographic alterations. Standard stipulations and project- and site-specific construction and reclamation procedures would be required for additional development on federal lands and these measures would further minimize cumulative impacts of surface geologic environment.

With the exception of shallow gas, no major surface mineral resources would be impacted by the implementation of the RFFA's. Protection of subsurface mineral resources is provided by the BLM casing and well bore cementing policy.

No cumulative adverse impacts are expected to occur to potential fossil resources beyond those discussed in Section 4.1.3.1 as a result of the Proposed Action or No Action alternative in combination with existing, proposed, and reasonably foreseeable actions. Adoption of mitigation measures prescribed in that section could foster cumulative beneficial impacts of the project by either resulting in the discovery of new fossil resources or providing paleontologists with evidence of absence of such resources in the area.

Table 5-1
Cumulative Assessment by Resource Value
Copper Ridge Shallow Gas Project

Resource Value	Cumulative Impact Analysis Area	Acreage in IAA (if applicable)	Existing Level of Disturbance or Activity[1]	Reasonably Foreseeable Development[2] (RFD) or Activity including:		Potential Cumulative Impacts (life-of-project disturbance only)
				Proposed Action[3] (PA)	No Action[4]	
Geo/Paleo-	CRPA	24,953	748.4 ac	171 ac	109 ac	Existing disturbance + PA would result in 541 ac of disturbance or 2.2% of the project area.
Minerals	Area from 191 east to boundary of CD/WII & DF project area	1,898464	34,060 ac	6,631 ac	6,569 ac	Existing disturbance, PA, + RFD would result in 40,691 ac or 2.1% of the area.
Air Quality	Near Field – Project Area + 12.4 miles Far Field -Regional including south half portion of WY, Northern CO, NE Utah including Bridger, Fitzpatrick, Popo Agie, Savage Run wilderness areas		On-going oil and gas related activity, coal mining, power generation, intra and interstate commerce	Addition of up to 1,292 wells and related facilities	Addition of up to 1250 wells and related facilities	Emissions would remain within federal and state thresholds.
Soils	Affected watersheds: Patrick Draw, Upper Black Butte Creek, Big Flat Draw, Lower Salt Wells Creek, Polly Draw	108,766	1,038 ac	171 ac	109 ac	Existing and PA would result in disturbance of in 1,209 ac of disturbance or 1.1% of the affected watersheds. Stabilization and reclamation measures required

Resource Value	Cumulative Impact Analysis Area	Acreage in IAA (if applicable)	Existing Level of Disturbance or Activity[1]	Reasonably Foreseeable Development[2] (RFD) or Activity including:		Potential Cumulative Impacts (life-of-project disturbance only)
				Proposed Action[3] (PA)	No Action[4]	
Water Resources	Surface Water – Affected watersheds: Patrick Draw, Upper Black Butte Creek, Big Flat Draw, Lower Salt Wells Creek, Polly Draw	108,766	1,038 ac	171 ac	109 ac	Existing and PA would result in disturbance of 1,209 ac or 1.1% within the affected watersheds. Avoidance and/or protective measures required.
	Groundwater – Expected drawdown area (cone of depression)	Approximately sub-surface 12,160 ac				Draw down of water within coal bearing seams would be depleted (injection into another formation) only to the extent to allow gas to desorb (reduce pressure so gas can flow freely). Two other shallow gas projects are proposed in the vicinity of the proposed project area although specific components are not known at this time, could result in overlap of cones of depression of the potentiometric surface (confined aquifer).
Vegetation/Wetlands	Expanded GRRMP area for general veg – south of I-80; east of Hwy 430, to approximately 6 mi+ east of RSFO boundary	2,664,228	35,314 ac	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance of 41,945 ac or 1.6% of the area assessed.
Rangeland/Other Land Uses	Rock Springs Grazing Allotment	2,127,200	27,736 ac	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance 34,367 ac or 1.6 % of the Allotment.
Wildlife – Big Game Species	South Rock Springs Mule Deer Herd Unit	1,477,156 (348,037 cwyrl)	22,449 ac (450 ac cwyrl)	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance of 29,080 ac or 1.9% of the herd unit. Existing disturbance + PA would result in 470 ac of disturbance (0.1%) of cwyrl range. Timing limitations required.
	Petition Elk Herd Unit	1,836,488 (27,388 cwyrl)	33,654 ac (220 ac cwyrl)	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance of 40,285 ac or 2.2% of the herd unit. The PA would not result in further disturbance to cwyrl range. RFD, timing limitation required in cwyrl range.

Resource Value	Cumulative Impact Analysis Area	Acreage in IAA (if applicable)	Existing Level of Disturbance or Activity[1]	Reasonably Foreseeable Development[2] (RFD) or Activity including: Proposed Action[3] (PA)	No Action[4]	Potential Cumulative Impacts (life-of-project disturbance only)
T/E/P/C/S Wildlife Species Note: PA - No effect determination for T/E/P/C species	Bitter Creek Antelope Herd Unit	1,835,828 (212,222 cwyrl)	35,604 ac (2,185 ac cwyrl)	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance of 45,343 ac or 2.5% of the herd unit. Existing disturbance + PA would result in 2,230 ac or 1.1% disturbance to cwyrl range. RFD - timing limitation required.
	Sage Grouse Lower Green River conservation planning area unit.	1,477,156 total (9,614 ac lek; 379,437ac potential nesting)	22,949 ac total 10 ac lek; 940 ac potential nesting)	6,631 ac total 0 Leks PA - 171 ac potential nesting	6,569 ac total 0 Leks No Action - 109 ac potential nesting	Existing, PA + RFD would result in disturbance of 29,580 ac or 2.0% of the conservation planning unit. The PA or RFD would not result in further disturbance to leks or ¼ mi buffer as no surface occupancy stipulations apply. The PA could disturb up to 171 ac of potential habitat or 0.3% of potential habitat found in planning unit. Foreseeable actions addressed on a case-by-case basis. Timing limitations or avoidance of usable habitat required.
	Raptors – CRPA + 2 mi buffer	66,362 (4,940ac nesting + ½ - 1 mi buffer)	748.4 ac	171 ac	109 ac	No cumulative effect. None of the proposed wells would be located within the ½ to 1 mi (depending on species of raptor) buffer of a known nest. Protective measures apply.
	Other Sensitive Species (ie, p-dogs, etc)	24,953	748.4 ac	171 ac	109 ac	Individuals could be adversely impacted (depending upon timing and amount of disturbance in a habitat type); however, populations would not be impacted. These species would benefit from application of protective measures.
T/E/P/C/SS Fish Species		Downstream CO River species				Existing disturbance handed on a case-by-case basis. “Affected but not likely to adversely effect” determination (wavier of impact fee approved by USFWS) for PA. RFD water depletions analyzed & mitigated on a case-by-case basis.
T/E/P/C/SS Plant Species	Range of each species	216	0 ac	0 ac	0 ac	No effect. Disturbance not allowed in range of each species.

Resource Value	Cumulative Impact Analysis Area	Acreage in IAA (if applicable)	Existing Level of Disturbance or Activity[1]	Reasonably Foreseeable Development[2] (RFD) or Activity including:		Potential Cumulative Impacts (life-of-project disturbance only)
				Proposed Action[3] (PA)	No Action[4]	
Wild horses	Salt Wells Creek and Adobe Town Wild Horse Herd Management Areas	1,573,585	18,410 ac	6,631 ac	6,569 ac	Exisitng, PA + RFD would result in disturbance of 25,041 ac or 1.6% of the WHHMAs.
Recreation	CRPA + southern Sweetwater County		Hunting, camping, hiking, ORV use, etc.			Some temporary displacement of hunters and recreationists during periods of drilling and construction. There could be reduced levels of satisfaction with the recreational experience but more vehicle access.
Visual Resources	CRPA + adjacent areas in southern Sweetwater County		On-going and proposed oil and gas related activity, coal mining, interstate traffic, livestock grazing, etc.			Exisitng, PA + RFD would result in continued use of public and non-public lands for energy production, commerce, recreation, and agricultural uses. Most activity would occur in Class IV (allows for major modification to landscape). Any activity in other VRM classifications would be mitigated according to classification requirements.
Cultural Resources	CRPA + 5 mi Buffer	156,341	1434.4 ac	171 ac	109 ac	Any activity requiring federal action is subject to compliance with Section 106 of the NHPA. Impacts to cultural resources are mitigated through the consultation process on a case-by-case basis.
Socio-Economics	Sweetwater County					Existing, PA + RFD would continue to contribute to the economic well-being of Sweetwater County (and increase state revenues). Continued employment opportunities would occur (no increases in employment expected).
Transportation	CRPA, Public Access into Area					The PA would result in minor increases in the level of traffic during drilling operations. Existing workers and service providers would be used if production occurs.

Resource Value	Cumulative Impact Analysis Area	Acreage in IAA (if applicable)	Existing Level of Disturbance or Activity[1]	Reasonably Foreseeable Development[2] (RFD) or Activity including:		Potential Cumulative Impacts (life-of-project disturbance only)
				Proposed Action[3] (PA)	No Action[4]	
Health/Safety	CRPA	24,953	370 ac	171 ac	109 ac	The PA would not add concerns to the health and safety of workers the project area since the same individuals would be involved with implementing the project.
Noise	CFPA	24,953	370 ac			The PA would not add to the existing noise level since drilling is a temporary operation within an area previously developed oil and gas activity. Best management practices would apply

1/ - Producing wells includes wells that are producing, shut-in, temporarily abandoned, and drilling (included because well would be partially or fully reclaimed depending on production). Disturbance is assumed to be 1.0 ac per producing well, road disturbance at 3.5 ac per producing well, and assumes all pipeline disturbance has been successfully reclaimed and revegetation stabilized although 0.5 ac of long-term disturbance from pipeline facilities per producing well (GRRMP FEIS, pg 674). Well data current as of 9/15/03. Other known and estimated disturbance includes:

- 7,004 ac – Black Butte Coal Mine (Sept 2003)
- 4 ac – Zeolite Mine
- 1,770 ac – County Roads
- 1,006 ac – Railroad and related facilities
- 1,006 ac – Interstate 80 (RSGA Allotment only)
- 6,746 ac – Jim Bridger Coal Mine (RSGA Allotment only)
- 640 ac – Jim Bridger Power Plant (RSGA Allotment only)
- 1,850 ac – Lucite Hills Coal Mine (RSGA Allotment only)
- 2,156 ac – OCI Trona Mine (RSGA Allotment only)
- 5,554 ac – Estimated disturbance from communication sites, non o/g-related roads, sub-stations, towns (outside of incorporated cities/towns), ranches, etc (25% of known disturbance).

Total estimated disturbance of non-o/g related disturbance of 16,344 acres and 27,736 ac disturbance in the RSGA.

Resource Value	Cumulative Impact Analysis Area	Acreage in IAA (if applicable)	Existing Level of Disturbance or Activity[1]	Reasonably Foreseeable Development[2] (RFD) or Activity including:		Potential Cumulative Impacts (life-of-project disturbance only)
				Proposed Action[3] (PA)	No Action[4]	

2/ - Reasonably foreseeable development includes the following:

- Remaining wells in the Rock Springs portion of the approved Continental Divide/Wamsutter II Natural Gas Project (273 wells approved as of 9/15/2003); 657 wells could be approved under the analysis completed;
- Remaining wells in the Approved Vermillion Basin Natural Gas Exploration and Production Project area; 52 wells could be approved under the analysis completed.
- Proposed development of 385 wells in the Desolation Flats Natural Gas Project area (under analysis).
- Proposed development of 120 wells in the Pacific Rim Shallow Gas Project area (pre-scoping phase).
- Proposed development of 61 wells in the Bitter Creek Shallow Gas Project area (pre-scoping phase)
- Possible development of 17 exploratory wells out side of specific project areas.

Total RFD of 1,292 wells or 6,460 acres using same disturbance assumptions mentioned above.

3/ - Assumes all 89 wells will be successful producers under the Proposed Action resulting in a LOP disturbance of 171 ac. Also assumes all wells approved under existing analyses will be drilled and produce fluid minerals successfully resulting in 6,460 ac of disturbance. Note: it is unlikely that all wells approved to date will be successful producers and does not recognize that depleted or uneconomic wells would be permanently abandoned.

4/ - Assumes 47 wells will be successful producers under the No Action Alternative resulting in a LOP disturbance of 109 ac. Also assumes all wells approved under existing analyses will be drilled and produce fluid minerals successfully resulting in another 6,460 ac of disturbance. Note: it is unlikely that all wells approved to date will be successful producers and does not recognize that depleted or uneconomic wells would be permanently abandoned.

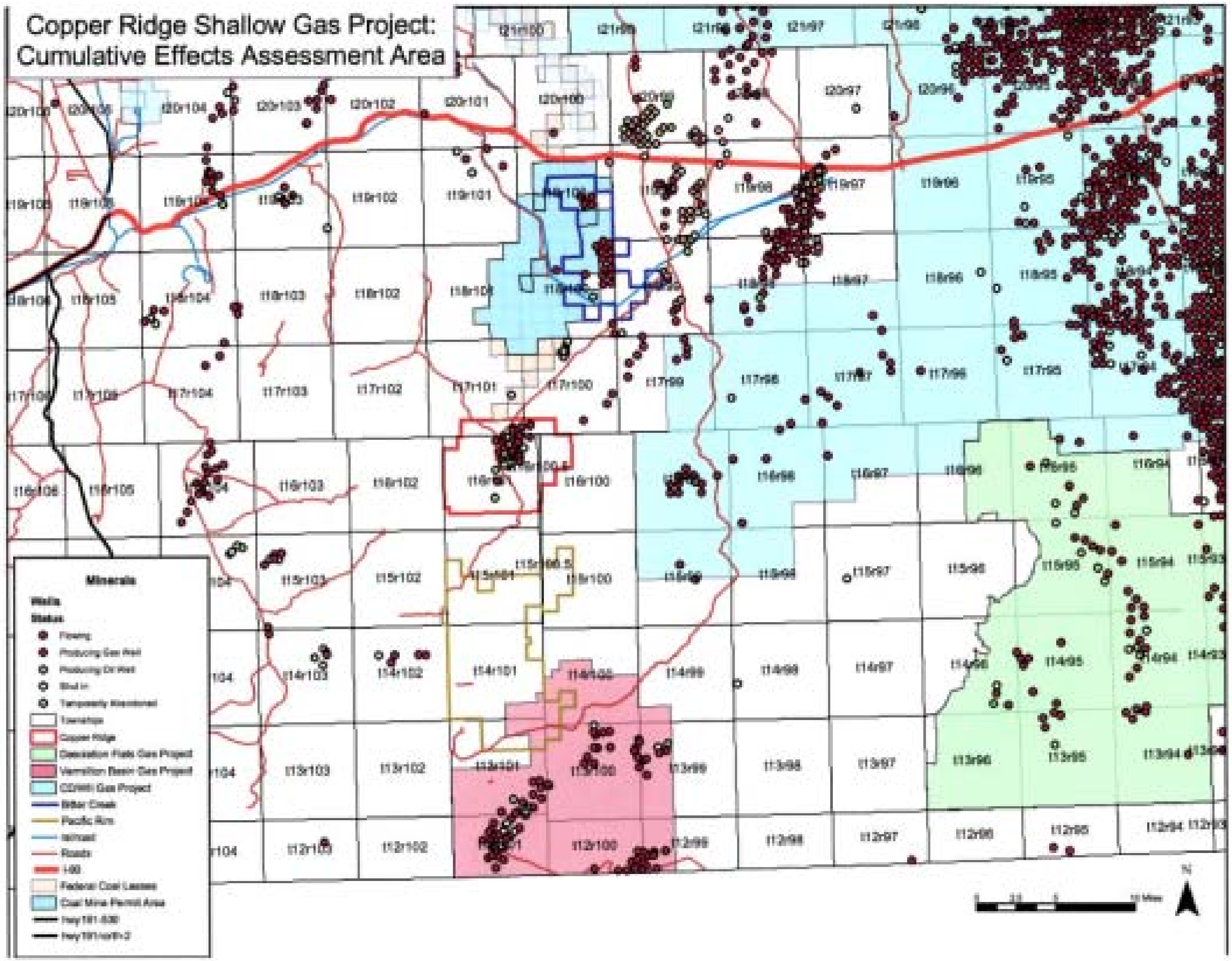


Figure 5-1. Cumulative Effects Assessment Area – Minerals.

5.3.2 Air Quality

Cumulative impacts from emissions resulting from the implementation of past oil and gas projects, along with the Proposed Action (or No Action) alternative would be much the same as those found on similar oil and gas projects such as Continental Divide, Pinedale Anticline, and Desolation Flats natural gas projects.

5.3.3 Soils

The CIA area for soils includes the affected watersheds encompassing 108,766 acres. Cumulative impacts include soil impacts from on-going exploration and development activities, recently constructed projects, and RFFA's, as described in Table 5.1. Cumulative disturbance of 1,209 acres would be approximately 1.1 percent of the 108,766-acre CIA area. This amount of cumulative impacts upon the soil resources would be minimal, provided that all mitigation and avoidance measures are implemented

5.3.4 Water Resources

The water resources CIA area includes the 108,766 acres encompassing the affected watersheds. Existing, proposed, and known future disturbance would result in 1,209 acres or 1.1 percent of the CIA area potentially disturbed. Any groundwater impact is expected to be minimal since drawdown would occur only to the extent needed to allow the gas to desorb. Cumulative disturbance would minimally impact surface water or groundwater quantity or quality.

The impacts predicted to occur are based upon the current knowledge of the geology, coal resource, and groundwater hydrology in the area. Both natural gas and water production rates from future shallow gas wells, and specifics related to groundwater injection, cannot be accurately predicted at this time. These variables could potentially affect the configuration of field production, gas processing, and gas and water conveyance facilities; however, none of these changes are expected to measurably affect the conclusions presented herein. Federal regulations provide for additional analysis if substantial changes in resource conditions would alter the conclusions reached herein.

Cumulative impacts to surface water resources would be maximized shortly after the start of construction activities, decreasing in time due to reclamation efforts, then stabilizing during the production/operation period when routine maintenance of wells and ancillary facilities takes place. Additionally, all roads, well locations, and facility infrastructure would be regularly inspected and maintained to minimize erosion, sedimentation, and surface water quality impairment.

Due to thick confining layers, wells completed in water-bearing strata above or below the Almond coal seams are not likely to be impacted.

Current and future oil and gas exploration and development activities in the Project Area must comply with federal and state environmental regulations. Therefore, impacts to groundwater quantity or quality on a cumulative scale are not expected. This is particularly true given the fact that wells would be completed in accordance with Onshore Order No. 2 and the recent BLM guidelines that reduce the potential for groundwater contamination.

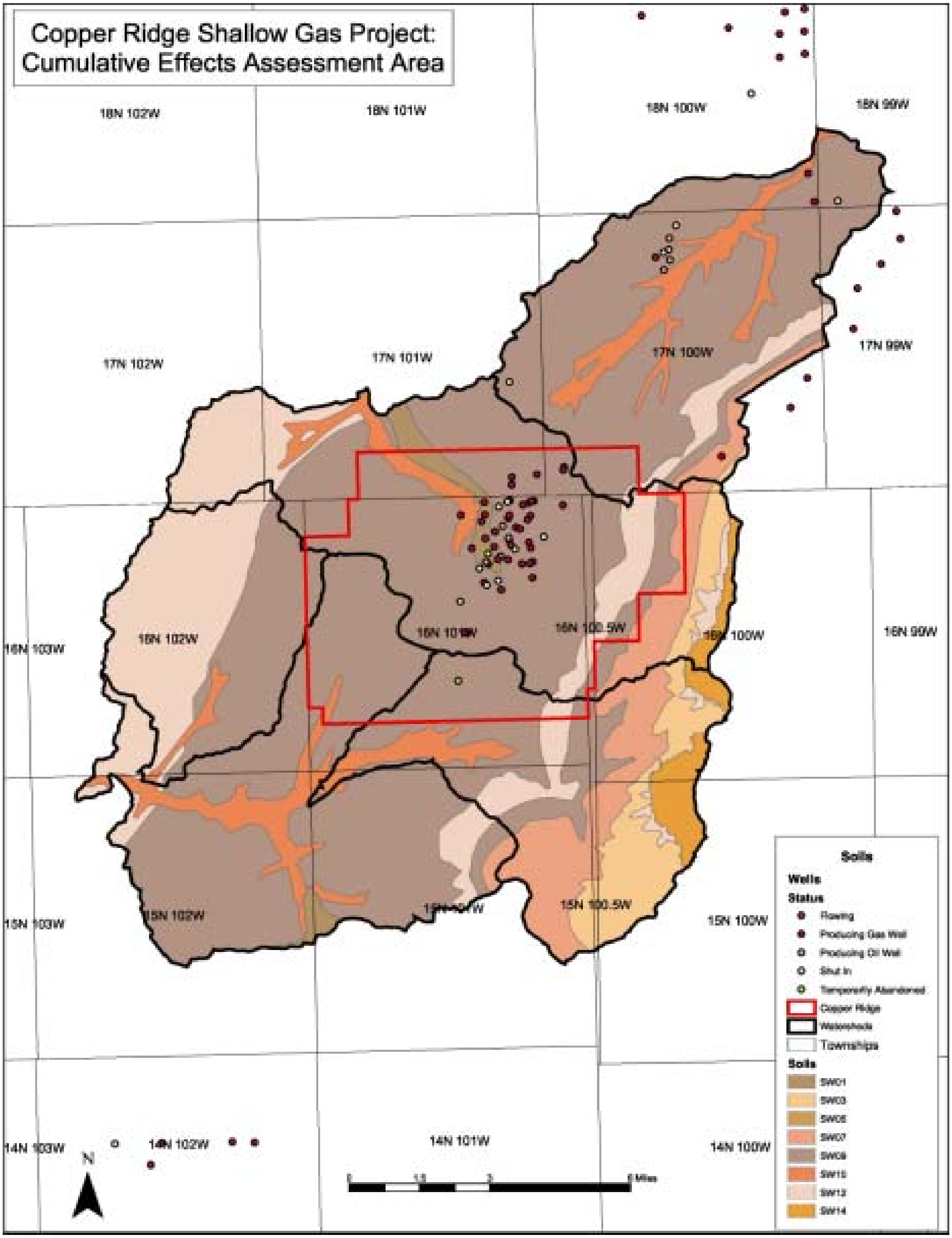


Figure 5-2. Cumulative Effects Assessment Area – Soils

5.3.5 Vegetation and Wetlands

The CIA area for vegetation and wetlands includes over 2.6 million acres. Cumulative impacts includes impacts to vegetation and wetlands from on-going exploration and development activities, recently constructed projects, the Proposed Action and known foreseeable actions.

Cumulative disturbance would result in 41,945 acres 1.6 percent of the CIA area. This amount of vegetation loss would be minimal, and no direct impacts of aquatic and riparian areas are expected because current proposed project activities would avoid these areas. Provided that soil erosion mitigation measures are followed, no indirect aquatic and riparian impacts are expected. Cumulative impacts upon both vegetation and wetland resources would be minimal, provided that all mitigation and avoidance measures are implemented.

5.3.6 Range Resources and Other Land Uses

The Rock Springs Grazing Allotment, containing 2,127,200 acres makes up the CIA for range resources and other land uses. Existing, proposed, and known foreseeable actions would result in the disturbance of 34,367 acres or 1.6 percent of the area. This disturbance results in a loss of 2,291 AUMs or 2.3 percent of the 97,358 active AUMs (this figure does not recognize suspended AUMs). Potential cumulative impacts to other land uses are limited to recreation resources and wildlife habitat, which are discussed under the sections dealing with those resources.

5.3.7 Wildlife

The CIA area varies with species, as indicated within the respective analyses. The disturbance of wildlife habitat resulting from implementation of the drilling program would reduce habitat availability and effectiveness for a variety of common mammals, birds and their predators. Initial phases of surface disturbance would result in some direct mortality to small mammals, displacement of songbirds, along with a slight increase in mortality from increased vehicle use in the immediate area.

Activities associated with the construction phase would likely temporarily displace antelope and mule deer; however, once construction is completed they would likely habituate and return to pre-disturbance activity patterns. Elk crucial winter/yearlong range does not occur in the area. Pronghorn crucial winter/yearlong occurs within the Project Area would be affected over the short-term; however, the Proposed Action would occur in an area where existing use by humans already occurs. Mule deer crucial winter/yearlong range occurs on 1,108 acres within the 24,898 acre project area (or 4.4 percent of the project area). The proportion of mule deer crucial winter/yearlong range within the South Rock Springs Herd Unit that would be affected existing and proposed disturbance would be 0.1 percent of the available crucial winter range. Construction activities on crucial winter/yearlong range would be limited to May 1 - Nov 14. Provided that mitigation measures contained in Chapter 2 and the RMP are implemented, cumulative impacts to big game populations within their respective herd units are expected to be minimal.

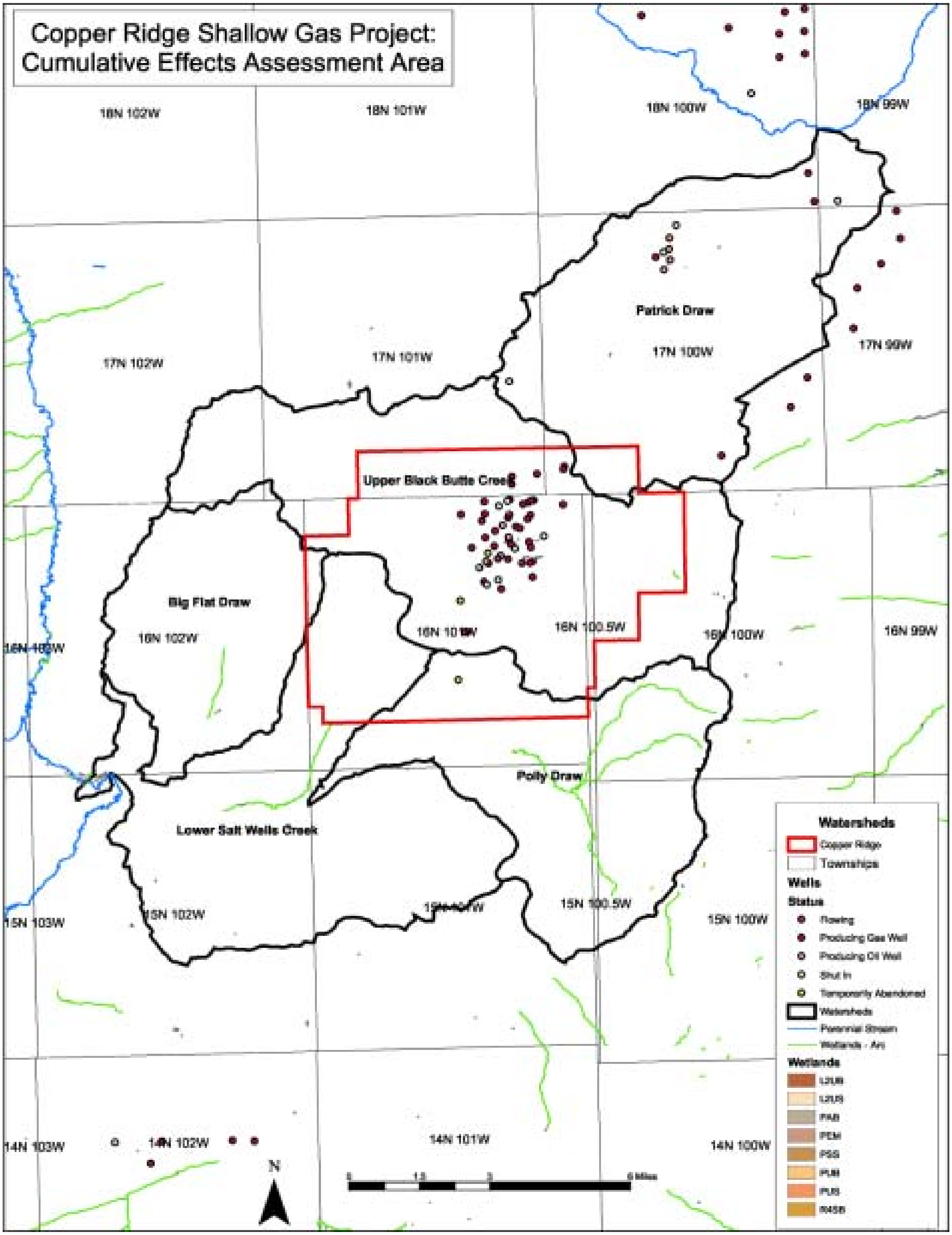


Figure 5-3. Cumulative Effects Assessment Area – Watersheds.

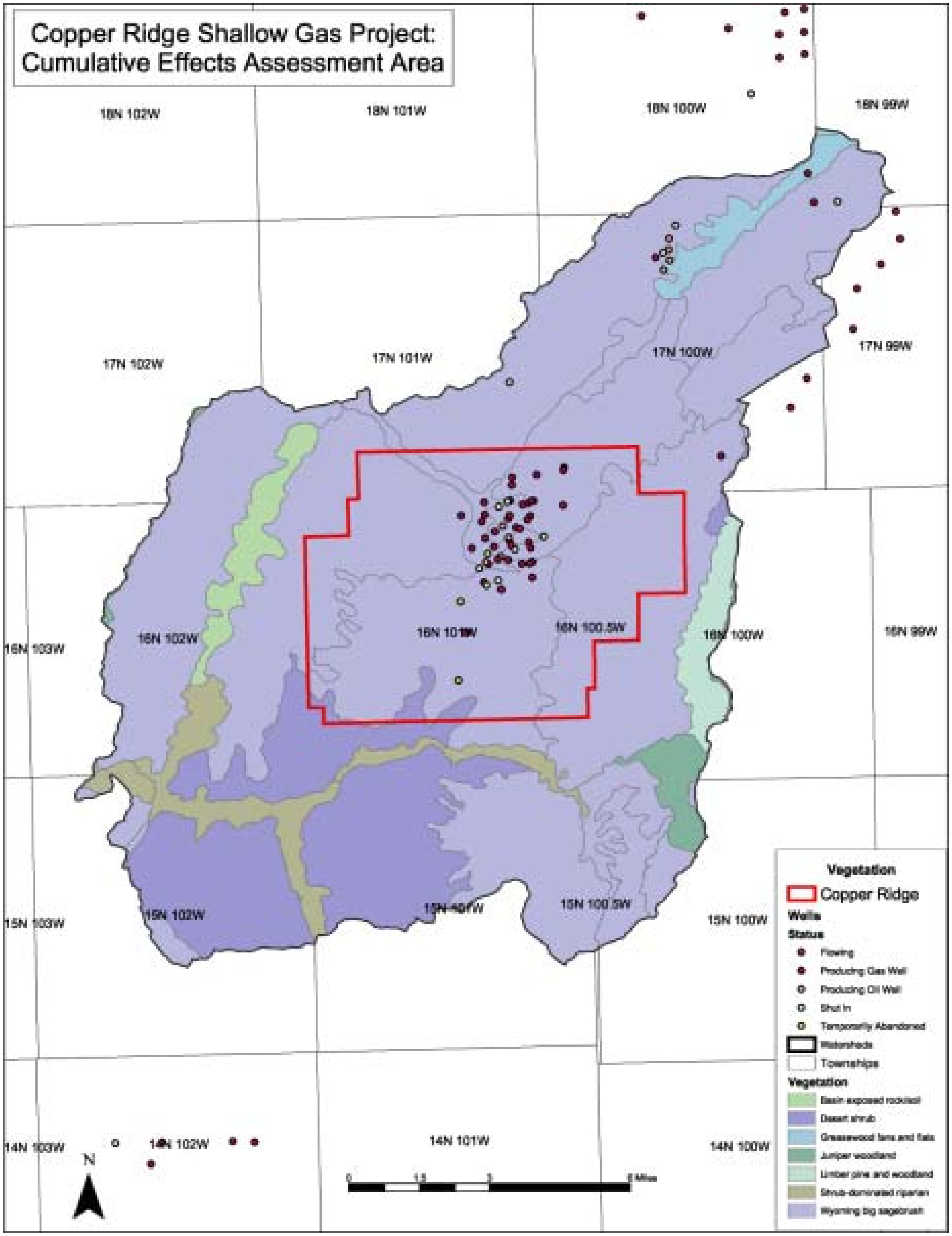


Figure 5-4. Cumulative Effects Assessment Area – Vegetation

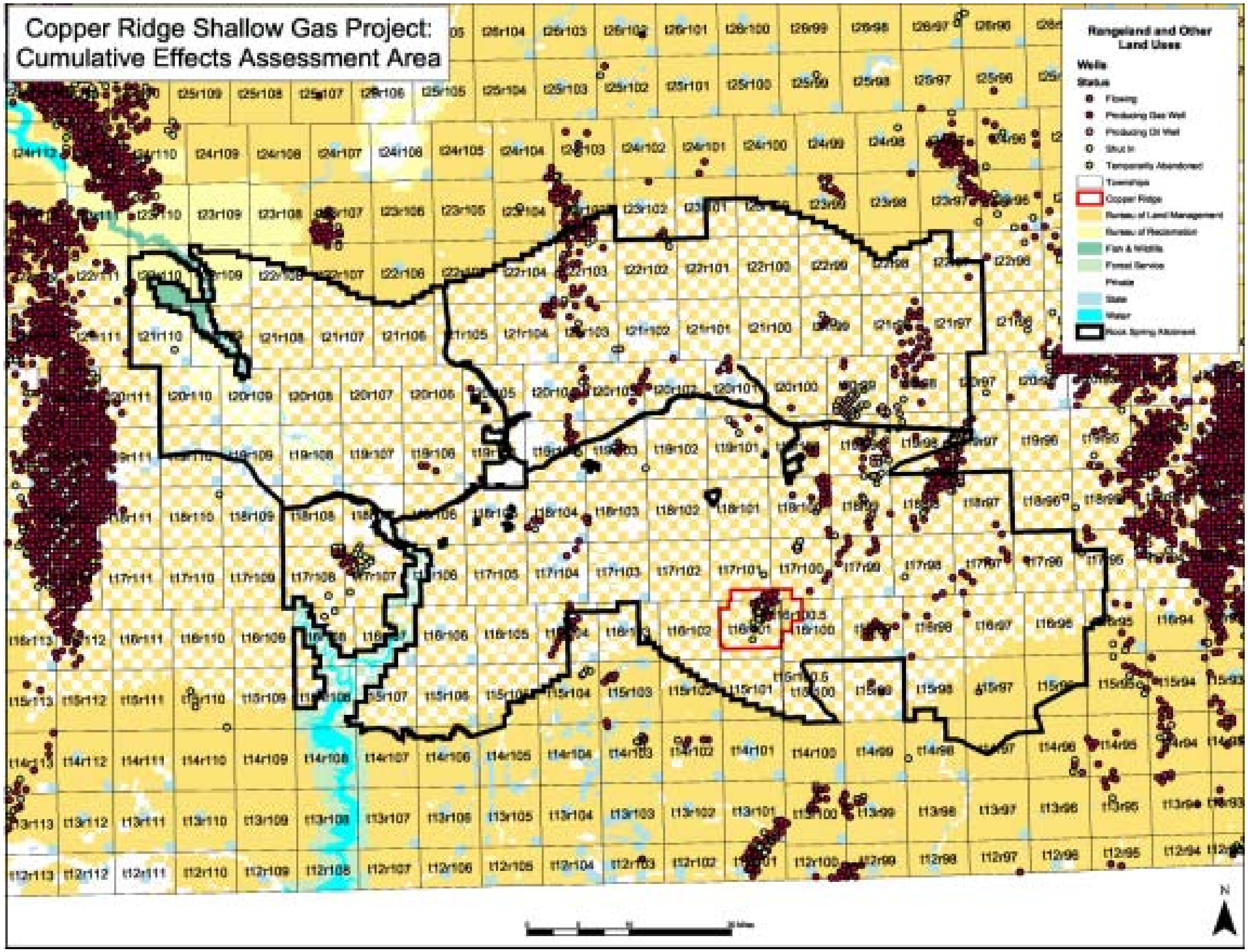


Figure 5-5. Cumulative Effects Assessment Area – Rangeland and Other Land Uses.

Greater sage-grouse within Lower Green River Basin Conservation Planning Unit would only be minimally impacted from the cumulative disturbance associated with the Proposed Action and other known foreseeable development provided the implementation of the NSO within ¼ mile of a lek, seasonal closures, reclamation, and committed mitigation measures are followed.

Although no active raptor nests were located within the Project Area during 2003 surveys, implementation of protection measures identified in Chapter 2 and the RMP are expected to protect the raptor populations.

5.3.8 Special Status Plant, Wildlife, and Fish Species

5.3.8.1 Plant Species

The distribution of plant species of concern is very limited within the Project Area due to a lack of suitable habitat for these species. The required application of existing FWS and BLM protective measures is expected to provide adequate protection for threatened, endangered, and special status plant species. Thus, no impacts to Special Status Plant Species are expected.

5.3.8.2 Wildlife Species

For known foreseeable actions, appropriate coordination or consultation with FWS is required. The required application of existing FWS and BLM monitoring and mitigation measures is expected to provide adequate protection for threatened, endangered, proposed or candidate plant species. Thus, impacts are expected to be minimal.

5.3.8.3 Fish Species

Formal consultation with FWS has been completed. Impact payments to the FWS for recovery efforts have been waived. All known foreseeable actions require consultation with the FWS is downstream fish are affected.

5.3.9 Recreation

BLM does not have statistics on historical use of the project area by recreation groups which could be used to determine trends in cumulative impacts on recreation use and displacement. Cumulatively, overall impacts to the recreation resource are expected to be minimal with some temporary displacement of hunters and recreationists during the short-term drilling periods. Some long-term displacement of hunters and non-consumptive users could occur, and there may be reduced levels of satisfaction for those who might continue to use the area.

5.3.10 Visual Resources

As discussed in Chapter 3, existing visual qualities in the CRPA and adjacent lands have already been affected by ongoing natural gas development, including road building and pipeline construction and other industrial uses (i.e., gas process, coal mining, grazing, etc). Existing, proposed, or reasonably foreseeable development would add to the level of impact to visual resources in the area. However, the cumulative impact of existing, proposed, or reasonably foreseeable development on visual resources would still be consistent with the current VRM

Class IV designation with implementation of mitigation measures proposed by Anadarko.

5.3.11 Cultural Resources

Cultural resources on public lands, including archaeological sites and historic properties, are protected by federal law and regulations. Current operations must comply with these protective regulations, and BLM requires the completion of cultural resource inventories prior to surface-disturbing activities. These inventories have been used to identify sites potentially eligible for inclusion on the National Register of Historic Places and to identify sites which BLM has required past exploration and development activities to avoid.

Because Class III cultural resource inventories must be completed, the potential for increased impacts on cultural artifacts would be minimized. By avoiding known cultural and historical sites during the layout of drill sites, access roads, and pipeline corridors, the potential for incremental increases in cumulative impacts would be avoided. Completion of cultural resource inventories would have a beneficial, cumulative impact on the level of cultural information about the project area. Some unintentional damage to subsurface resources could occur during grading or excavation activities. However, implementation of resource protection and mitigation measures described in Chapter 2 would protect such resources upon discovery.

5.3.12 Socioeconomics

Southwest Wyoming is currently experiencing an increase in the pace and level of natural gas development. Drilling and field development is occurring in areas near the CRPA including Continental Divide/Wamsutter II area, Vermillion Basin area, and other fields (Brady, Table Rock, Baxter Basin). While this surge in development will result in increased employment, income and tax revenues in the region, it will also result in increased housing demand and increased demand for local and state government facilities and services.

Communities such as Rock Springs are still below peak population levels of the 1980's and have infrastructure and housing to accommodate population growth. At the recent pace of development, neither the relatively small, short-term drilling and field development workforce or the minimal operations employment and activity associated with the existing, proposed, nor reasonably foreseeable development would add appreciably to cumulative housing and local government service demand in the area.

If the current pace of drilling and field development in southwest Wyoming continues, however, the potential for degradation of the quality of some recreation resources in the area would increase. If Carbon County residents perceive that degradation of recreation resources has occurred, levels of dissatisfaction among some residents and area visitors would correspondingly increase.

5.3.13 Transportation

Increased oil and gas development in Sweetwater County will result in increased traffic on affected segments of I-80, WSH 430, and affected County Roads. The condition of these highways is adequate to accommodate existing and increased levels of traffic.

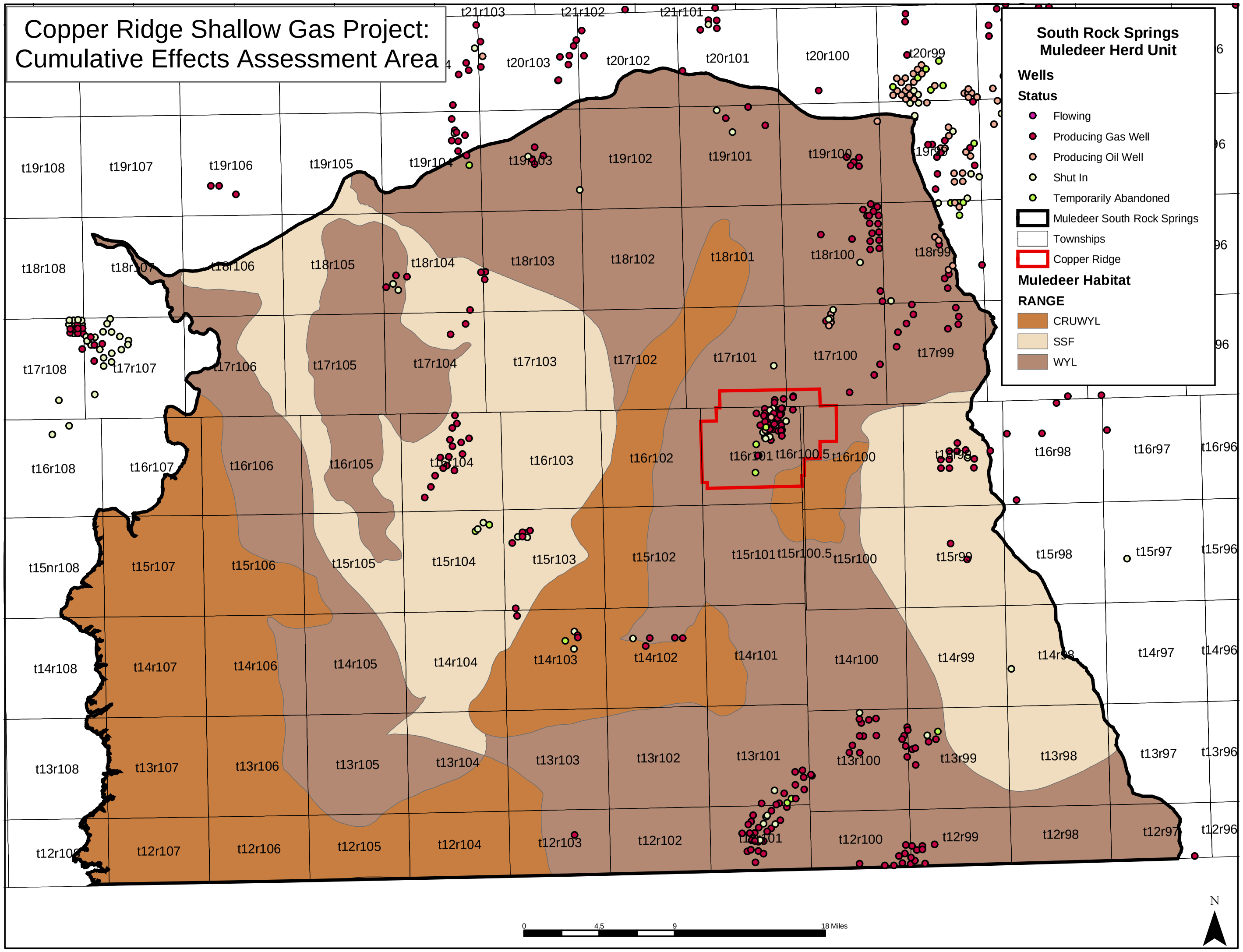


Figure 5-6. Cumulative Effects Assessment Area – Mule Deer.

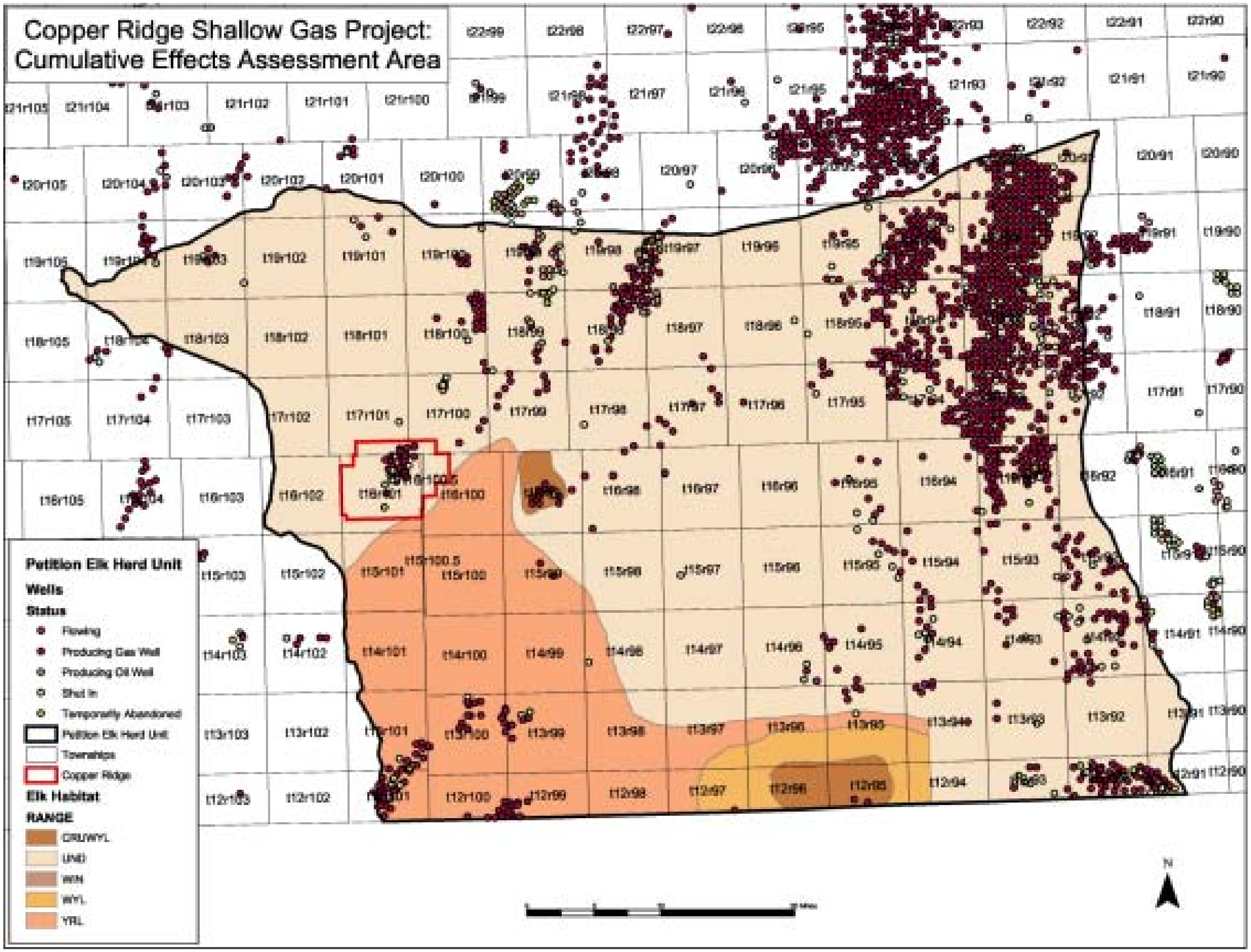


Figure 5-7. Cumulative Effects Assessment Area – Elk.

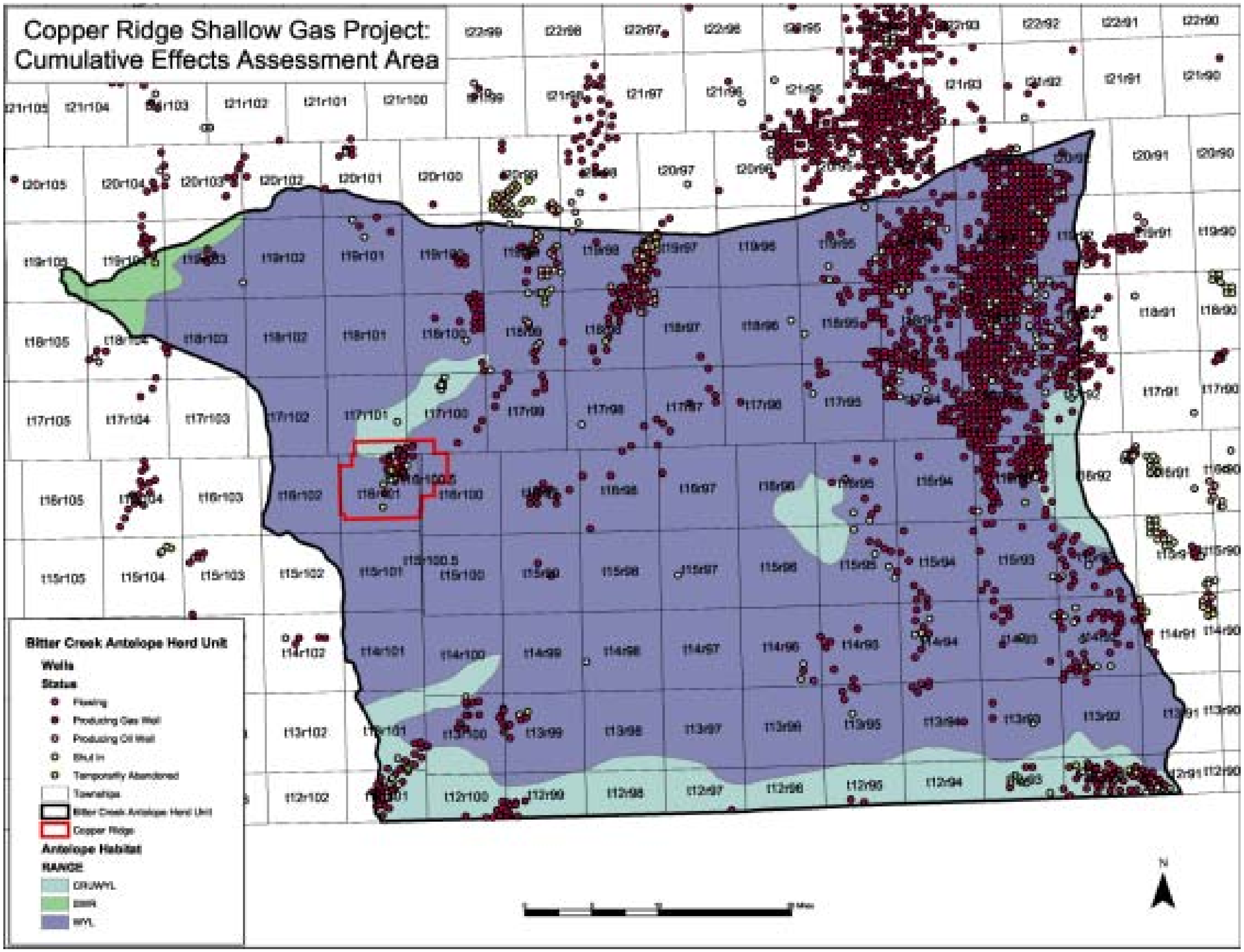


Figure 5-8. Cumulative Effects Assessment Area – Antelope.

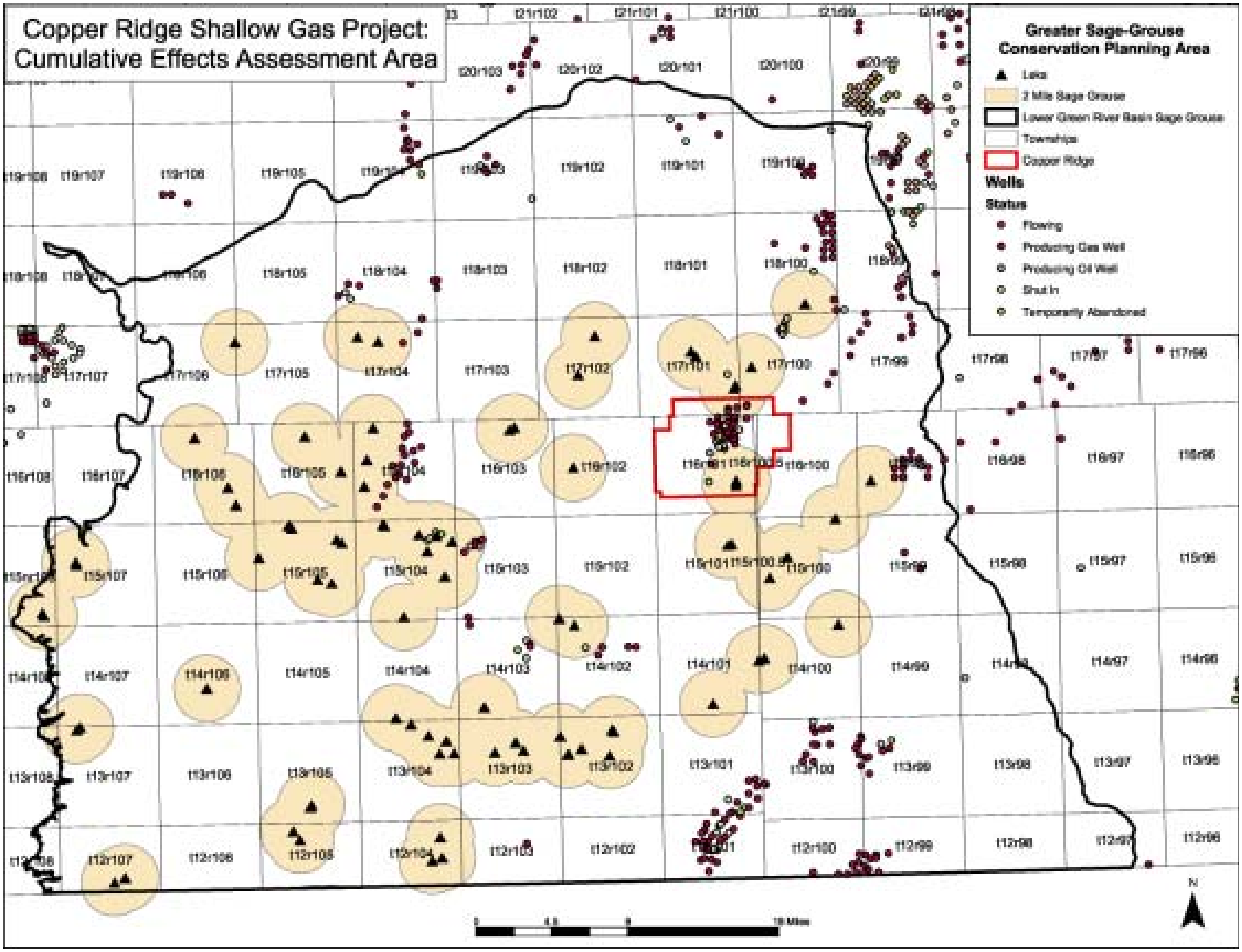


Figure 5-9. Cumulative Effects Assessment Area – Sage Grouse.

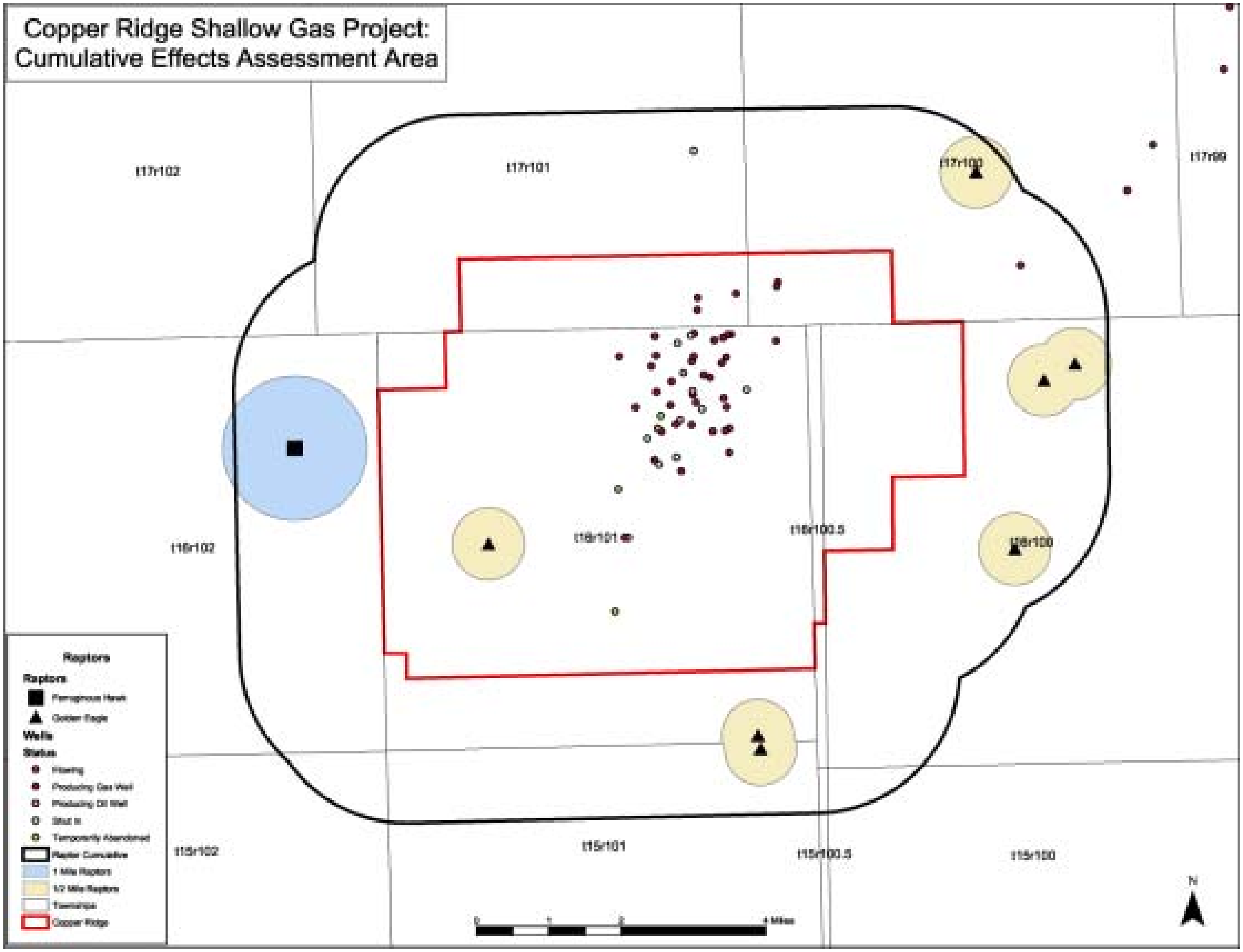


Figure 5-10. Cumulative Effects Assessment Area – Raptors.

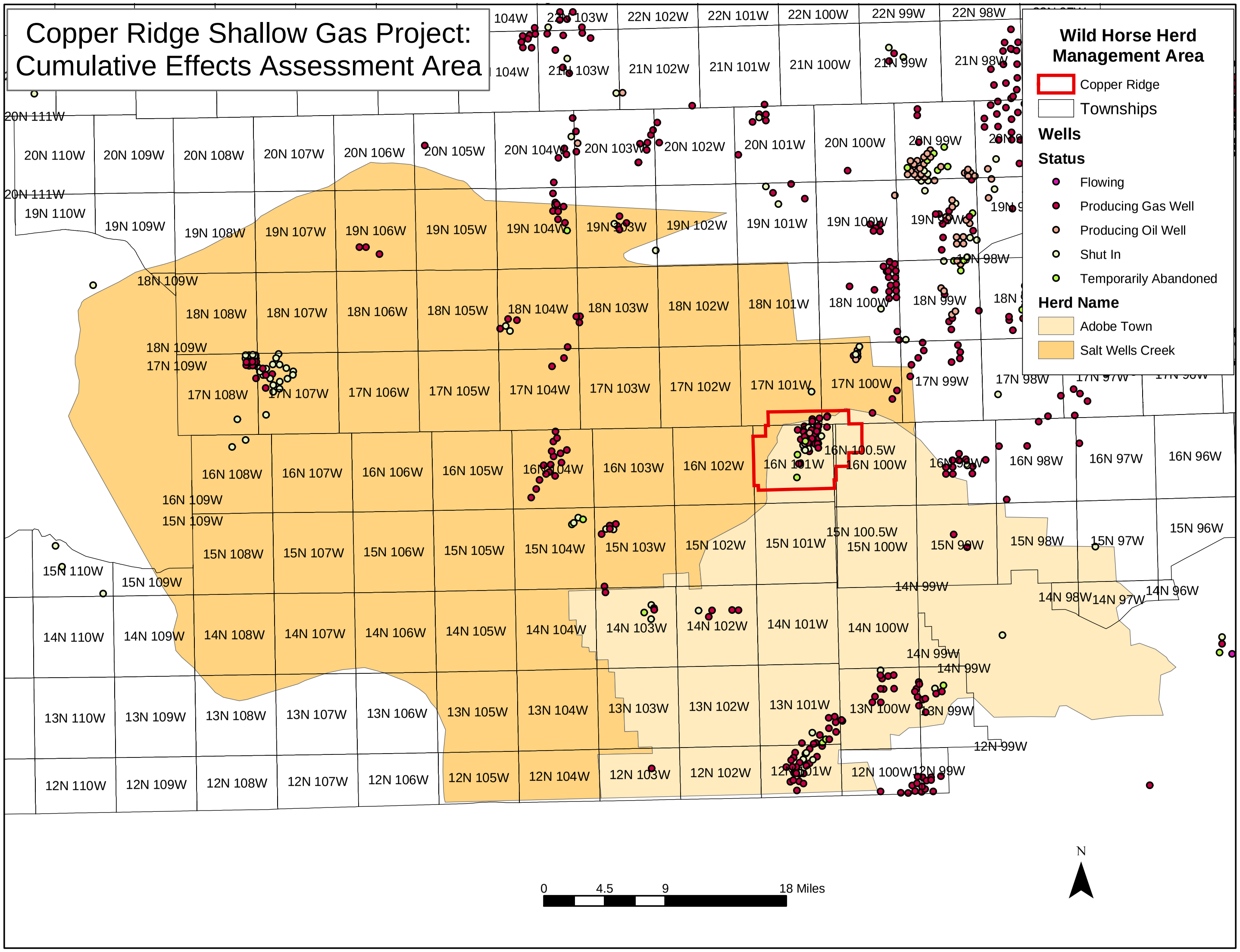


Figure 5-11. Cumulative Effects Assessment Area – Wild Horses.

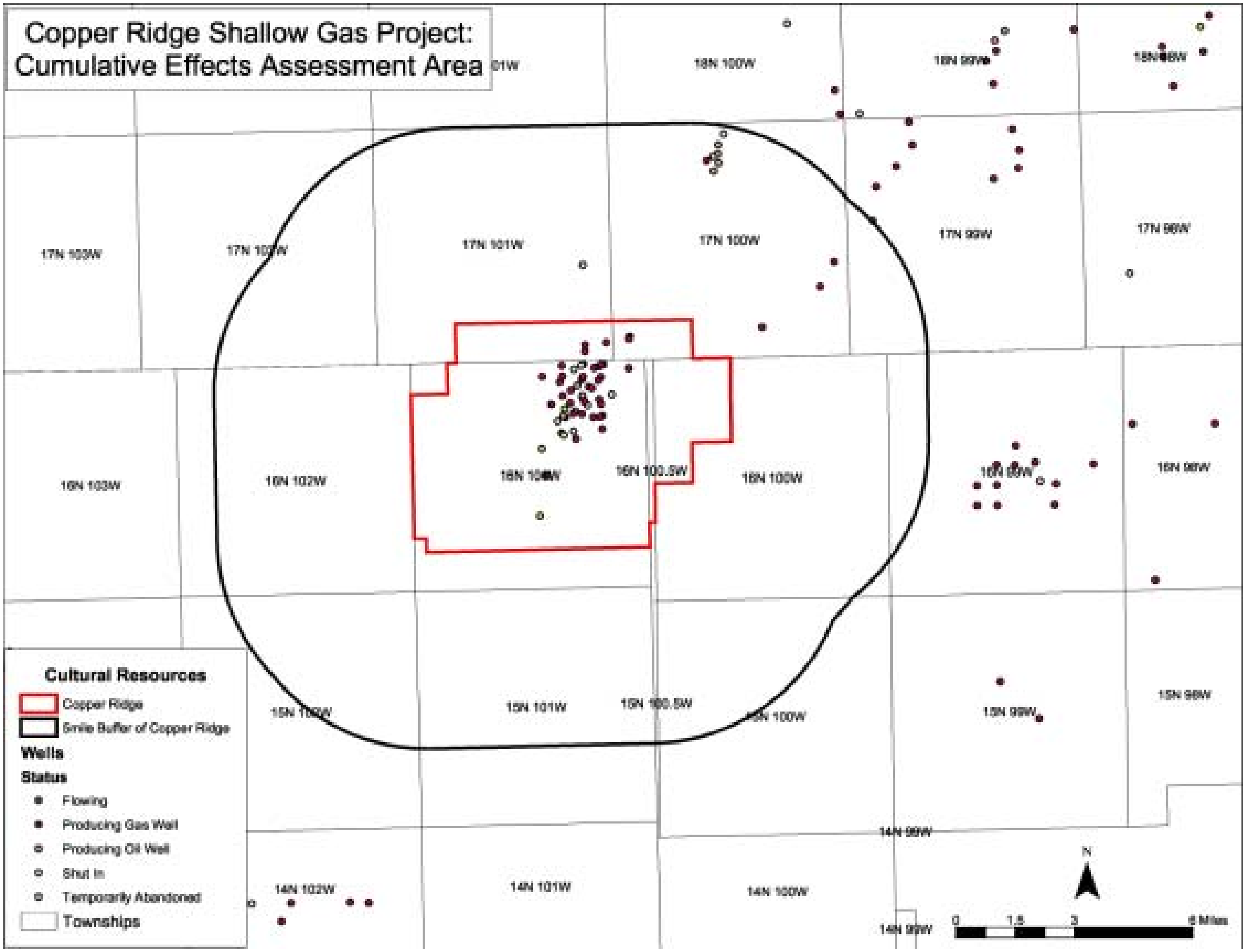


Figure 5-12. Cumulative Effects Assessment Area – Cultural Resources.

5.3.14 Health and Safety

Cumulative health and safety impacts would be limited to those associated with the proposed drilling proposal and existing grazing and recreation activities. Occasional traffic and activity associated with oil and gas exploration activities would generate small increases in risks to project workers and the public. Cumulative impacts to health and safety conditions are anticipated to be similar to those described for the Proposed Action.

5.3.15 Noise

Noise would result from on-going construction, drilling, and production operations during the life of the project. Increased traffic on existing transportation system roads within the project area would occur, thus adding to existing traffic noise. Given the current and anticipated traffic volumes and dispersed nature of traffic and operations within the CRPA, the projected additions to cumulative, traffic-related noise impacts would be minimal. Use of best available technology requirements for compressors and other equipment would help limit the level of noise.

Based on analysis of the cumulative effects for the identified areas by resource and considering that existing, proposed, and foreseeable actions would result in the disturbance of no more than 2.5% of any one area assessed, the proposed action would not result in considerable degradation to the resource.

CHAPTER 6

CONSULTATION AND COORDINATION

6.0 CONSULTATION AND COORDINATION

An environmental assessment (EA) must be prepared when a federal government agency considers approving an action within its jurisdiction that may impact the human environment. An EA aids federal officials in making decisions by presenting information on the physical, biological, and social environment of a proposed project and its alternatives. The first step in preparing an EA is to determine the scope of the project, the range of action alternatives, and the impacts to be included in the document.

The Council on Environmental Quality (CEQ) regulations (40 CFR, Parts 1500-1508) require an early scoping process to determine the issues related to the proposed action and alternatives that the EA should address. The purpose of the scoping process is to identify important issues, concerns, and potential impacts that require analysis in the EA and to eliminate insignificant issues and alternatives from detailed analysis.

The Copper Ridge Shallow Gas Project EA was prepared by a third party contractor working under the direction of and in cooperation with the lead agency for the project, which is the Bureau of Land Management (BLM), Rock Springs Field Office, Rock Springs, Wyoming.

6.1 PUBLIC PARTICIPATION

A Scoping Notice was prepared and submitted to the public by the BLM on November 15, 2002 requesting input into the proposed Copper Ridge project. Scoping documents were sent out to the public listed on the BLM mailing list, as well as organizations, groups, and individuals requesting a copy of the scoping document.

There were nine written responses received during the scoping period in response to this project. These written responses did not state a position in regard to the project but provided suggested mitigation if the project were implemented. The issues and concerns identified by the public during the scoping period are summarized in Chapter 1.

During preparation of the EA, the BLM and the consultant interdisciplinary team (IDT) have communicated with, and received or solicited input from various federal, State, county, and local agencies, elected representatives, environmental and citizens groups, industries, and individuals potentially concerned with issues regarding the proposed drilling action. The contacts made are summarized in the following sections.

The following organizations/individuals either provided comment or were provided the opportunity to comment during the scoping period.

CHAPTER 6: CONSULTATION AND COORDINATION

FEDERAL AGENCIES

U.S. Army Corps of Engineers
U.S. Environmental Protection Agency, Region 8
U.S. Senator Michael B. Enzi
U.S. Fish and Wildlife Service
U.S. Representative Barbara Cubin
U.S. Senator Craig Thomas

STATE AGENCIES

Governor, Dave Freudenthal
State Representatives
Wyoming Department of Transportation
Wyoming Oil and Gas Conservation Commission
Wyoming Department of Environmental Quality
State Senators
Wyoming Office of Federal Land Policy
Wyoming Game and Fish Department
Wyoming State Historic Preservation Office

COUNTY GOVERNMENT

Sweetwater County Commissioners
Sweetwater County Planner

MUNICIPALITIES

Mayor of Rock Springs
Mayor of Superior
Mayor of Green River
Postmaster of Farson

NATIVE AMERICAN TRIBES

Eastern Shoshone National
Northern Ute Cultural Committee
Shoshone-Bannock Tribes
Northern Arapaho Business
Shoshone-Bannock Tribal Office

LOCAL MEDIA

A press release was sent to local media.

LANDOWNERS, INDUSTRY REPRESENTATIVES, AND GRAZING PERMITTEES

This scoping notice has been sent to known property owners, industry representatives, and grazing permittees that would be affected by this project.

PUBLIC LAND USERS AND USER GROUPS

National Wildlife Federation
Oregon/California Trails Association
Southwest Wyoming Industrial Association
People for the West
Independent Petroleum Assoc. of Mountain States
Petroleum Association of Wyoming
Sierra Club Northern Plains Representative
Sierra Club – Wyoming Chapter
Rocky Mountain Elk Foundation
Rock Springs Grazing Assoc.
Biodiversity Conservation Alliance
The Wilderness Society
The Nature Conservancy
Trout Unlimited
Western Mule Deer Foundation
Wyoming Outdoor Council

Environmental Defense Fund

Wyoming Public Lands Council

6.2 LIST OF PREPARERS

The following tables identify the core BLM IDT (Table 5-1) and the consultant IDT (Table 5-2) that were principally involved with preparing this EA.

Table 6-1. List of BLM Interdisciplinary Reviewers

Name	Responsibility
ROCK SPRINGS FIELD OFFICE	
Teri Deakins	Project Manager
John MacDonald	Soils/Pipeline construction/reclamation
Susan Davis	Petroleum Engineer
Jim Dunder	Wildlife/T & E Issues
Kevin Lloyd	Range Management Specialist – Wild Horses
Jim Glennon	Zone Botanist
Terry A. Del Bene	Cultural Resources
Jo Foster	Recreation
Jennifer Bates	Realty
Dennis Doncaster	Hydrology/Water Quality
Dave Chase	Petroleum Engineer
Sherry Blackburn	Geology
Lance Brady	GIS
Ted Murphy	Acting Field Manager
Bernie Weynand	Acting Field Manager - Resources
WYOMING STATE OFFICE	
Susan Caplan	Air Quality
Dale Hanson	Paleontologist
State of Wyoming	
Darla Potter	Visibility, Smoke Mgt., EIS Coordinator

Table 6-2. List of Consultant Interdisciplinary Team EA Preparers

Principal Interdisciplinary Team		
Name	**Affiliation**	**Responsibility**
Gary Holsan	Gary Holsan Environmental Planning	Interdisciplinary Team Leader, Project Manager
Doug Henderer	Buys and Associates	Air Quality
Jan Yerkovich	Western Archaeological Services	Cultural Resources
Charles Bucans, P.E.	Star Valley Engineering	Editor/Writer
Larry Bennett	Hayden-Wing Associates	Vegetation, Wetlands, Wild Horses
Larry Hayden-Wing	Hayden-Wing Associates	Wildlife, T,E, & S Species
Gus Winterfeld	Erathem Vanir Geological	Geology, Soils, Paleontology
Mike Evers	WWC Engineering	Water Quality
George Blankenship	Blankenship Associates	Recreation, Visual, Socioeconomics, Safety, Transportation, Noise

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Appendix A Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
BIRDS				
Acorn woodpecker	*Melanerpes lewis*		X	
American avocet	*Recurvirostra americana*		X	
American bittern	*Botaurus lentiginosus*		X	
American coot	*Fulica americana*		X	
American crow	*Corvus brachyrhynchos*		X	
American goldfinch	*Carduelis tristis*		X	
American kestrel	*Falco sparverius*	X	X	
American pipit	*Anthus rubescens*		X	
American redstart	*Setophaga ruticilla*		X	
American robin	*Turdus migratorius*		X	
American tree sparrow	*Spizella arborea*		X	
American white pelican	*Pelecanus erythrorhynchos*		X	
American wigeon	*Anas Americana*		X	
Ash-throated flycatcher	*Myiarchus cinerascens*		X	
Baird's sandpiper	*Calidris bairdii*		X	
Bald eagle	*Haliaeetus luecocephalus*	X	X	
Bank swallow	*Riparia riparia*		X	
Barn owl	*Tyto alba*		X	
Barn swallow	*Hirundo rustica*		X	
Barrow's goldeneye	*Bucephala islandica*		X	
Belted kingfisher	*Ceryle alcyon*		X	
Bewick's wren	*Thryomanes bewickii*		X	
Black rosy-finch	*Leucosticte atrata*		X	
Black tern	*Chlidonias niger*		X	
Black-bellied plover	*Pluvialis dominicus*		X	
Black-billed magpie	*Pica pica*	X	X	
Black-crowned night heron	*Nycticorax nycticorax*		X	
Black-necked stilt	*Himantopus mexicanus*		X	
Black-throated gray warbler	*Dendroica caerulescens*		X	
Black-throated sparrow	*Amphispiza bilineata*		X	
Blue grosbeak	*Guiraca caerulea*		X	
Blue grouse	*Dendragapus obscurus*		X	
Blue-gray gnatcatcher	*Polioptila caerulea*		X	
Blue-winged teal	*Anas discors*	X	X	
Bobolink	*Dolichonyx oryzivorus*		X	
Bonaparte's gull	*Spizella breweri*		X	
Brewer's blackbird	*Selasphorus platycercus*	X	X	
Brewer's sparrow	*Euphagus cyanocephalus*	X	X	X
Broad-tailed hummingbird	Selasphorus platycercus		X	
Broad-winged hawk	*Buteo platypterus*		X	
Brown thrasher	*Taxostoma rufum*		X	
Brown-capped rosy-finch	*Leucosticte australis*		X	
Brown-headed cowbird	*Molothrus ater*		X	
Bufflehead	*Bucephala albeola*		X	
BIRDS CONT'D				
Bullock's oriole	*Icterus bullockii*		X	
Burrowing owl	*Athene cunicularia*		X	
Bushtit	*Psaltriparus minimus*	X	X	
California gull	*Larus californicus*		X	
Calliope hummingbird	*Stellula calliope*		X	
Canada goose	*Branta canadensis*		X	

Appendix A Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
Canvasback	*Aythya valisineria*		X	
Canyon wren	*Catherpes mexicanus*	X	X	
Caspian tern	*Sterna caspia*		X	
Cassin's finch	*Carpodacus cassinii*		X	
Cattle egret	*Bubulcus ibis*		X	
Cedar waxwing	*Bombycilla cedrorum*		X	
Chestnut-collared longspur	*Calcarius ornatus*		X	
Chipping sparrow	*Spizella passerina*	X	X	
Cinnamon teal	*Anas cyanoptera*	X	X	
Clark's grebe	*Aechmophorus clarkii*		X	
Clark's nutcracker	*Nucifraga columbiana*		X	
Clay-colored sparrow	*Spizella pallida*		X	
Cliff swallow	*Hirundo pyrrhonota*		X	
Common goldeneye	*Bucephala clangula*		X	
Common grackle	*Quiscalus quiscula*		X	
Common loon	*Gavia immer*	X	X	
Common merganser	*Mergus merganser*		X	
Common nighthawk	*Chordeiles minor*	X	X	
Common poorwill	*Phalaenoptilus nuttallii*		X	
Common raven	*Corvus corax*		X	
Common redpoll	*Carduelis flammea*		X	
Common snipe	*Gallinago gallinago*		X	
Common tern	*Sterna hirundo*		X	
Common yellowthroat	*Geothylpis trichas*		X	
Cooper's hawk	*Accipiter cooperii*	X	X	
Cordilleran flycatcher	*Empidonax occidentalis*		X	
Dark-eyed junco	*Junco hyemalis*	X	X	
Double-crested cormorant	*Phalacrocorax auritus*		X	
Downy woodpecker	*Picoides pubescens*		X	
Dunlin	*Calidris alpina*		X	
Dusky flycatcher	*Empidonax oberholseri*		X	
Eared grebe	*Podiceps nigricollis*		X	
Eastern kingbird	*Tyrannus tyrannus*		X	
European starling	*Sturnus vulgaris*		X	
Evening grosbeak	*Coccothraustes vespertinus*		X	
Ferruginous hawk	*Buteo regalis*	X	X	
Forster's tern	*Sterna forsteri*		X	
Fox sparrow	*Passerella iliaca*		X	
BIRDS CONT'D				
Franklin's gull	*Larus pipixcan*		X	
Gadwall	*Anas strepera*		X	
Golden eagle	*Aquila chrysaetos*	X	X	
Golden-crowned kinglet	*Regulus satrapa*		X	
Grasshopper sparrow	*Ammodramus savannarum*		X	
Gray catbird	*Dumetella carolinensis*		X	
Gray flycatcher	*Empidonax wrightii*		X	
Gray jay	*Perisoreus canadensis*		X	
Gray-crowned rosy-finch	*Leucosticte tephrocotis*	X	X	
Great horned owl	*Bubo virginianus*	X	X	
Great-blue heron	*Ardea herodias*	X	X	
Greater scaup	*Anthya marila*		X	
Greater yellowlegs	*Tringa melanoleuca*		X	

Appendix A Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
Green-tailed towhee	*Pipilo chlorurus*	X	X	
Green-winged teal	*Anas crecca*		X	
Hairy woodpecker	*Picoides villosus*		X	
Hermit thrush	*Catharus guttatus*		X	
Herring gull	*Larus argentatus*		X	
Hooded merganser	*Lophodytes cucullatus*		X	
Horned grebe	*Podiceps auritus*		X	
Horned lark	*Eremophila alpestris*	X	X	
House finch	*Carpodacus mexicanus*	X	X	
House sparrow	*Passer domesticus*		X	
House wren	*Troglodytes aedon*		X	
Juniper titmouse	*Baeolophus griseus*		X	
Killdeer	*Charadrius vociferus*	X	X	
Lark bunting	*Calamospiza melanocorys*	X	X	
Lark sparrow	*Chondestes grammacus*		X	
Lazuli bunting	*Passerina ameoena*		X	
Least sandpiper	*Calidris minutilla*		X	
Lesser scaup	*Aythya affinis*		X	
Lesser yellowlegs	*Tringa flavipes*		X	
Lewis' woodpecker	*Melanerpes lewis*		X	
Lincoln's sparrow	*Melospiza lincolnii*		X	
Loggerhead shrike	*Lanius ludovicianus*	X	X	
Long-billed curlew	*Numenius americanus*	X	X	
Long-billed dowitcher	*Limnodromus scolopaceus*		X	
Long-eared owl	*Asio otus*	X	X	
Macgillivray's warbler	*Oporornis tolmiei*		X	
Mallard	*Anas platyrhynchos*	X	X	
Marbled godwit	*Limosa fedora*	X	X	
Marsh wren	*Cistothorus palustris*		X	
McCown's longspur	*Calcarius mccownii*		X	
Merlin	*Falco columbarius*	X	X	
<u>BIRDS CONT'D</u>				
Mountain bluebird	*Sialia currucoides*	X	X	
Mountain chickadee	*Parus gambeli*		X	
Mountain plover	*Charadrius montanus*		X	
Mourning dove	*Zenaida macroura*	X	X	
Nashville warbler	*Vermivora ruficapilla*		X	
Northern flicker	*Colaptes auratus*	X	X	
Northern goshawk	*Accipiter gentilis*	X	X	
Northern harrier	*Circus cyaneus*	X	X	
Northern mockingbird	*Mimus polyglottos*		X	
Northern pintail	*Anas acuta*		X	
Northern rough-winged swallow	*Stelgidopteryx serripennis*		X	
Northern shoveler	*Anas clypeata*		X	
Northern shrike	*Lanius excubitor*		X	
Oldsquaw	*Clangula hyemalis*		X	
Olive-sided flycatcher	*Contopus borealis*		X	
Orange-crowned warbler	*Vermivora celata*		X	
Pacific loon	*Gavia pacifica*		X	
Peregrine falcon	*Falco peregrinus*		X	
Pied billed grebe	*Podilymbus podiceps*		X	
Pine siskin	*Carduelis pinus*		X	

Appendix A Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
Pinyon jay	*Gymnorhinus cyanocephalus*	X	X	
Plumbeous vireo	*Vireo plumbeus*		X	
Prairie falcon	*Falco mexicanus*	X	X	
Red crossbill	*Loxia curvirostra*		X	
Red knot	*Calidris canutus*		X	
Red phalarope	*Phalaropus fulicaria*		X	
Red-breasted merganser	*Mergus serrator*		X	
Red-breasted nuthatch	*Sitta canadensis*	X	X	
Redhead	*Aythya americana*		X	
Red-headed woodpecker	*Melanerpes erythrocephalus*		X	
Red-naped sapsucker	*Sphyrapicus nuchalis*		X	
Red-necked grebe	*Podiceps grisegena*		X	
Red-necked phalarope	*Phalaropus lobatus*		X	
Red-tailed hawk	*Buteo jamaicensis*	X	X	
Red-winged blackbird	*Agelaius phoeniceus*		X	
Ring-billed gull	*Larus delawarensis*		X	
Ring-necked duck	*Aythya collaris*		X	
Rock dove	*Columba livia*	X	X	
Rock wren	*Salpinctes obsoletus*	X	X	
Rose-breasted grosbeak	*Pheucticus ludovicianus*		X	
Ross' goose	*Chen rosii*		X	
Rough-legged hawk	*Buteo lagopus*		X	
Ruby-crowned kinglet	*Regulus calendula*		X	
Ruddy duck	*Oxyura jamaicensis*		X	
<u>BIRDS CONT'D</u>				
Rufous hummingbird	*Selasphorus rufus*		X	
Sabine's gull	*Xema sabini*		X	
Sage grouse, greater	*Centrocercus urophasianus*	X	X	
Sage sparrow	*Amphispiza belli*	X	X	
Sage thrasher	*Oreoscoptes montanus*	X		
Sanderling	*Calidris alba*		X	
Sandhill crane	*Grus canadensis*	X	X	
Savannah sparrow	*Passerculus sandwichensis*		X	
Say's phoebe	*Sayornis saya*	X	X	
Scott's oriole	*Icterus parisorum*		X	
Semipalmated plover	*Charadrius semiplamatus*		X	
Semipalmated sandpiper	*Calidris pusilla*		X	
Sharp-shinned hawk	*Accipiter striatus*		X	
Short eared owl	*Asio flammeus*	X	X	
Short-billed dowitcher	*Limnodromus griseus*		X	
Snow bunting	*Plectrophenax nivalis*		X	
Snow goose	*Chen caerulescens*		X	
Snowy egret	*Egretta thula*		X	
Snowy owl	*Nyctea scandiaca*		X	
Snowy plover	*Charadrius alexandrinus*		X	
Solitary sandpiper	*Tringa solitaria*		X	
Song sparrow	*Melospiza melodia*		X	
Sora	*Porzana carolina*		X	
Spotted sandpiper	*Actitis macularia*		X	
Steller's jay	*Cyanocitta stelleri*		X	
Stilt sandpiper	*Calidris himantopus*		X	
Surf scoter	*Melanitta perspicillata*		X	

Appendix A   Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
Swainson's hawk	*Buteo swainsoni*	X	X	
Swainson's thrush	*Catharus ustulatus*		X	
Three-toed woodpecker	*Picoides tridactylus*		X	
Townsend's solitaire	*Myadestes townsendii*		X	
Townsend's warbler	*Dendroica townsendii*		X	
Tree swallow	*Tachycineta bicolor*		X	
Trumpeter swan	*Cygnus buccinator*		X	
Tundra swan	*Cygnus columbianus*		X	
Turkey vulture	*Cathartes aura*		X	
Veery	*Catharus fuscescens*		X	
Vesper sparrow	*Pooecetes gramineus*	X	X	
Violet-green swallow	*Tachycineta thalassina*		X	
Virginia rail	*Rallus limicola*		X	
Virginia's warbler	*Vermivora virginiae*		X	
Warbling vireo	*Vireo gilvus*		X	
Western grebe	*Aechmophorus occidentalis*		X	
Western kingbird	*Tyrannus verticalis*		X	
BIRDS CONT'D				
Western meadowlark	*Sturnella neglecta*	X	X	
Western sandpiper	*Calidris mauri*		X	
Western scrub-jay	*Apheloma californica*		X	
Western tanager	*Piranga ludoviciana*		X	
Western wood-peewee	*Cantopus sordidulus*		X	
Whimbrel	*Numenius phaeopus*		X	
White-breasted nuthatch	*Sitta carolinensis*		X	
White-crowned sparrow	*Zonotrichia leucoophrys*		X	
White-faced ibis	*Plegadis chihi*		X	
White-throated swift	*Aeronautes saxatalis*	X	X	
White-winged crossbill	*Loxia leucoptera*		X	
White-winged scoter	*Melanitta fusca*		X	
Willet	*Catotrophorus semipalmatus*		X	
Williamson's sapsucker	*Sphyrapicus thyroideus*		X	
Willow flycatcher	*Empidonax traillii*		X	
Wilson's phalarope	*Phalaropus tricolor*		X	
Wilson's warbler	*Wilsonia pusilla*		X	
Wood duck	*Aix sponsa*		X	
Yellow warbler	*Dendroica petechia*		X	
Yellow-breasted chat	*Icteria virens*		X	
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*		X	
Yellow-rumped warbler	*Dendroica coronata*		X	
MAMMALS				
Badger	*Taxidea taxus*	X	X	
Beaver	*Castor canadensis*		X	
Big-brown bat	*Eptesicus fuscus*		X	
Bison	*Bison bison*	X	X	
Black-footed ferret	*Mustela nigripes*		X	
Bobcat	*Felis rufus*	X	X	
Bushy-tailed wood rat	*Neotoma cinerea*		X	
Canyon mouse	*Peromyscus crinitus*		X	
Cliff chipmunk	*Tamias dorsalis*		X	
Coyote	*Canis latrans*	X	X	
Deer mouse	*Peromyscus maniculatus*		X	

Appendix A Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
Desert cottontail	*Sylvilagus audubonii*	X	X	
Dusky shrew	*Sorex monticolus*		X	
Dwarf shrew	*Sorex nanus*		X	
Elk	*Cervus elaphus*	X	X	
Golden-mantled groundsquirrel	*Spermophilus lateralis*	X	X	
Great Basin pocket mouse	*Perognathus parvus*		X	
Hoary bat	*Lasiurus cinereus*		X	
Least chipmunk	*Tamias minimus*		X	
Least chipmunk	*Tamias minimus*		X	
MAMMALS CONT"D				
Least chipmunk	*Tamias minimus*		X	
Long-eared myotis	*Myotis evotis*		X	
Long-legged myotis	*Myotis volans*		X	
Long-tailed vole	*Microtus longicaudus*		X	
Long-tailed weasel	*Mustela frenata*	X	X	
Masked shrew	*Sorex cinereus*		X	
Meadow vole	*Microtus pennsylvanicus*		X	
Montane vole	*Microtus montanus*		X	
Mountain (Nuttall's) cottontail	*Sylvilagus nuttallii*	X	X	
Mountain lion	*Felis concolor*	X	X	
Mule deer	*Odocoileus hemionus*	X	X	
Muskrat	*Ondatra zibethicus*		X	
Northern grasshopper mouse	*Onychomys leucogaster*		X	
Northern pocket gopher	*Thomomys talpoides*		X	
Olive-backed pocket mouse	*Perognathus fasciatus*		X	
Ord's kangaroo rat	*Dipodomys ordii*		X	
Pinyon mouse	*Peromyscus truei*		X	
Pronghorn antelope	*Antilocapra americana*		X	
Pygmy rabbit	*Brachylagus idahoensis*		X	
Red fox	*Vulpes vulpes*		X	
Sagebrush vole	*Lemmiscus curtatus*		X	
Short-tailed (ermine) weasel	*Mustela erminea*		X	
Silky pocket mouse	*Perognathus flavus*		X	
Striped skunk	*Mephitis mephitis*		X	
Thirteen-lined groundsquirrel	*Spermophilus tridecemlineatus*		X	
Townsend's big-eared bat	*Plecotus townsendii*		X	
Uinta groundsquirrel	*Spermophilus armatus*	X		
Vagrant shrew	*Sorex vagrans*		X	
Western harvest mouse	*Reithrodontomys megalotis*		X	
Western small-footed myotis	*Myotis ciliolabrum*		X	
White-tailed jackrabbit	*Lepus townsendii*		X	
White-tailed prairie dog	*Cynomys leucurus*	X	X	X
Wild horse	*Equus caballus*	X		
Wyoming ground squirrel	*Spermophilus elegans*		X	
Wyoming pocket gopher	*Thomomys clusius*		X	
Yellow-bellied marmot	*Marmota flaviventris*		X	
Yellow-pine chipmunk	*Tamius amoenus*		X	
AMPHIBIANS				
Boreal chorus frog	*Pseudacris triseriata maculata*		X	
Boreal toad	*Bufo boreas boreas*		X	
Great Basin spadefoot toad	*Scaphiopus intermontanus*		X	
Tiger salamander	*Ambystoma tigrinum*		X	

Appendix A Wildlife species observed or that may potentially occur on or near the Copper Ridge Project Area.

Common Name	Scientific Name	Data Sources* WOS	ATLAS	WYNDD
REPTILES				
Eastern short horned lizard	*Phrynosoma douglassi brevirostre*		**X**	
Great Basin gopher snake	*Pituophis melanoleucas deserticola*		**X**	
Northern sagebrush lizard	*Sceloporus graciosus graciosus*		**X**	
Nothern plateau lizard	*sceloporus undulatus elongatus*		**X**	
Prairie rattlesnake	*Crotalus vinidus vinidus*		**X**	
Wandering garter snake	*Thamnophis elegans vagrans*		**X**	

*Data Sources
- WGFD Wildlife Observation System (2002c)
- Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming (WGFD 1999)
- Wyoming Natural Diversity Database (2002)