U.S. Department of the Interior
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Wyoming State Office

Rock Springs Field Office September 2004

ENVIRONMENTAL ASSESSMENT, FINDING OF NO SIGNIFICANT IMPACT and DECISION RECORD for the Pacific Rim Shallow Gas Exploration and Development Project, Sweetwater County, Wyoming

MISSION STATEMENT

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

BLM/WY/PL-04/030+1310

ENVIRONMENTAL ASSESSMENT, FINDING OF NO SIGNIFICANT IMPACT AND DECISION RCORD

FOR

PACIFIC RIM SHALLOW GAS EXPLORATION AND DEVELOPMENT PROJECT

Prepared for

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

WY-040-EA04-008

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.

September, 2004

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Rock Springs Field Office
280 Highway 191 North
Rock Springs, Wyoming 82901-3447

1792, 1310 (040)
Pacific Rim Shallow
Gas Project

September 1, 2004

Dear Reader:

The Bureau of Land Management (BLM) is providing you with a copy of the Environmental Assessment (EA), Finding of No Significant Impact (FONSI), and Decision Record (DR) for Warren E&P Pacific Rim Shallow Gas Exploration and Development Project.

The EA has been prepared pursuant to the National Environmental Policy Act, and other regulations and statutes, to analyze and determine the possible adverse environmental impacts which could result from Warren's proposal (Proposed Action and No Action Alternative) and to ensure that all reasonable mitigation measures have been identified. This EA is also intended to provide information to other regulatory agencies for use in their decision making process for other permits required for implementation of the project.

The DR identifies BLM's decision, explains the rationale for the reaching the decision, and includes Warren's committed measures and additional mitigation requirements for the Pacific Rim Project Area.

The BLM released a scoping notice to the public on October 17, 2003 and 15 comment letters were received. BLM has provided responses to all comments received during that 30-day comment period. Comment letters received during public scoping have been considered and documented in the analysis and/or decision (Appendix A of decision).

A copy of this EA/FONSI/DR has been sent to government entities, individuals, and organizations who commented on this project or have expressed an interest in mineral-related activities proposed on public lands. The BLM wishes to thank those individuals and organizations who provided input during this analysis process. If you should have any questions regarding this document, please contact Darlene Horsey, Project Lead, at the address shown above or phone (307) 352-0335.

Sincerely,

Michael R. Holbert

Michael R. Holbert
Field Manager

Enclosure

DECISION RECORD
FINDING OF NO SIGNIFICANT IMPACT
For
PACIFIC RIM SHALLOW GAS
EXPLORATION AND DEVELOPMENT PROJECT

INTRODUCTION

Warren E & P, Inc. (Warren) has notified the Bureau of Land Management (BLM), Rock Springs Field Office that they propose to explore and potentially develop shallow gas within the administrative boundary of the Rock Springs Field Office. The Pacific Rim Shallow Gas Project Area (PRPA) is generally located in Townships 13, 14 and 15 North, and Ranges 100 through 101 West, 6th Principal Meridian, Sweetwater County, Wyoming (see attached map).

The total project area encompasses approximately 47,597 acres. 41,738.60 acres are federal surface and minerals; 1,319.38 acres are State of Wyoming surface and minerals; 640 acres are State of Wyoming surface and federal minerals; 640 acres are private surface and federal minerals; and 3259.84 acres are private surface and minerals. Access to the area is U.S. Highway 430, Sweetwater County Road No. 24, and other existing or newly constructed roads.

The PRPA overlies an area mostly unexplored for natural gas. Since 1954, one producing well has been drilled and developed, five natural gas wells have been drilled and shut-in, and ten non-producing wells have been drilled, plugged and abandoned.

Warren proposes to drill a maximum of 120 wells. Drilling is expected to last for approximately two to four years, with a projected life-of-project (LOP) of 15 to 20 years.

Approximately 5 to 7 days would be required to drill, log, and run casing for each well, three additional days would be required to run a bond log, perforate the well casing and run an electric pump. The size of each drill site location will be approximately 180 feet by 270 feet (or 1.13 acres), and only those areas necessary to conduct drilling and completion operations would be cleared of vegetation. It is possible that some site disturbance may be required to place the drill rig on level ground. A reserve pit would be constructed on each drill site location to hold drilling fluids and cuttings. The reserve pit would be lined to prevent leakage and would be approximately 55 feet wide, 75 feet long and 10 feet deep. Drilling depths within the project area would vary from approximately 1,500 feet to 5,500 feet. Water for drilling purposes would be obtained from natural gas wells previously drilled and located within the area or water will be trucked in from Rock Springs, WY.

Each well would be designed with a 2” water discharge line and a 4” gas line extending from the individual well site to a 6” trunk line. Disposal of produced water, if any, would be through injection wells. No surface disposal or discharge of produced water is proposed. A separator may be needed at some or all well locations along with metering equipment.

Following drilling, completion and testing, flowlines and gathering facilities would be installed on commercial wells. Equipment would be powered by natural gas fired generators until powerlines could be constructed. Gas lines would be tied into compressor stations. The volume of produced gas would dictate the need for compression. An estimate of 5 compressors was identified in the EA each having a maximum of 2,300 horsepower. The locations of the compressors have not been identified at this time. Additional mitigation measures may be identified and applied during applications for permit to drill (APD) and rights-of-way (ROW) application reviews.

Currently, several existing roads access the proposed project area. These roads are both developed and undeveloped. The gas produced within the Pacific Rim Project area would be transported by both new and existing pipelines.

If the wells are non-productive or non-economical, they would be appropriately plugged; and all disturbed areas would be recontoured, reseeded, and otherwise reclaimed in compliance with applicable federal, state, or private landowner specifications.

A public scoping notice was released on October 17, 2003 for a 30-day review period. Fifteen comment letters were received and comments received during that period were considered and documented in the analysis. Comments received can be found in Appendix A of this decision.

ALTERNATIVES CONSIDERED

The Environmental Assessment for the Pacific Rim Shallow Gas Project analyzed two alternatives. The Proposed action considered exploration and potential drilling of 120 shallow gas wells for both technical and economic reasons. Of the 120 wells, 108 would be located on public lands managed by the BLM, 8 would be located on private lands, and 4 would be located on State of Wyoming lands. 120 wells was determined by Warren to be the minimum number necessary to implement this project and 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. Additionally, 120 wells provides flexibility in repositioning a pod or group of wells in the event that the exploratory drilling attempts encounter poor quality reservoirs or indicate a need to drill future wells on denser spacing. The 120-well proposal also provides a sufficient number of wells to effectively dewater the target reservoirs. Drilling is expected to last approximately two to four years, with a projected LOP of 10 to 20 years.

The Proposed Action considers drilling on 160 acre spacing. The proposed well count permits an examination of reservoir and geological properties, as well as characteristics that allow for production from depths of 1,000 feet to 6,500 feet. Wells would target sandstone reservoirs and coal seams within the Almond Formation. In addition to wellpads and associated construction, Warren anticipates that additional infrastructure such as access roads, compression facilities, and pipelines would be necessary to develop this resource. Additional gas volumes would be transported via existing trunk pipelines, but additional gathering and transmission pipelines are anticipated, depending on the drilling success. The Proposed Action is discussed in-depth in Chapter 2, Proposed Action and Alternatives.

Under the No Action Alternative, the BLM examined the conditions associated with surface disturbance for roads and pipelines. Drilling on federal lands would not be allowed with a no action decision, the 108 wells proposed for federal surface would not be allowed. This alternative provides a benchmark, enabling the decisionmakers to compare the magnitude of environmental effects of the alternatives.

No other alternatives were analyzed in detail. Exploration activities were centered where the best geologic and hydrologic information could be obtained outside of sensitive areas.

ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Horizontal or directional drilling might allow the clustering of surface facilities; however, this alternative has not been given further consideration for the following reasons:

- Economics. Horizontally drilled wells are estimated to cost 1.5 to 10 times as much as similar vertically drilled wells with no commensurate increase in production. This is due to the requirement of drilling as many laterals to develop the gas resource in a formation as there are coal seams. In addition, horizontal laterals would not be economical in thin coal seams because the cost of each lateral would exceed the return on ultimate gas recovery. In conventional drilling, thin coal seams will contribute to overall production; therefore maximizing recovery of the gas resource.

- Reservoir Issues. The science of coalbed methane gas wells does not warrant drilling horizontal wells for the purpose of intersecting naturally occurring vertical fractures. The coal seams of the Almond Coal formation contain several seams ranging in thickness from 1 to 10 feet. Some Almond coal seams may correlate between wells over long distances, but there are 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 seams locations, directional or horizontal drilling will not produce the desired results.

DECISION

Based upon the analysis of the potential environmental impacts described in the Environmental Assessment for the Pacific Rim Shallow Gas Project and in consideration of the public, industry, and governmental agency comments received during the public scoping, the BLM approves the Proposed Action as described in Chapter 2 of the EA for the exploration and potential drilling of 120 wells and associated facilities within the PRPA. The decision incorporates a Summary of Scoping Notice Comments and BLM Responses in Appendix A; Project – Wide Mitigation and Procedures in Appendix B; Additional BLM Required Mitigation identified in Appendix C; U.S. Fish and Wildlife Service Final Conference Opinion or Conformation letter in Appendix D; Black-Footed Ferret Survey Results in Appendix E; Standard Seed Mixtures in Appendix F; and Wilderness Inventory and Study Procedures in Appendix G.

APPOVED PROJECT COMPONENTS

This decision authorizes processing of APD or ROW applications for the following project components on BLM-administered public lands and/or minerals within the PRPA, subject to the requirements identified in Appendices B, C, and F of this decision. Approval of component permits is required prior to surface activities.

- Development of 120 shallow gas wells in the PRPA, of which 108 wells will be located on federal lands managed by the BLM. Construction of well pads on federal lands will cause an estimated initial total disturbance of 119 acres and a LOP disturbance of 22 acres.

- Construction of approximately 35.64 miles of new access roads, of which approximately 32.1 miles will be on federal lands. Estimated initial disturbance on federal lands would be 130 acres with the LOP disturbance at 115 acres.

- Construction of new gas lines and water gathering lines is approximately 35.64 miles with the estimated initial disturbance on federal lands at 130 acres. The lines would be wholly reclaimed resulting in LOP disturbance of zero acres.

- Construction of a compressor site with an approximate disturbance area of 4.5 acres.

As proposed, all production water will be reinjected into existing water disposal wells located within the project area. Other ancillary facilities may be necessary to meet the production needs. These facilities include but are not limited to:

- Produced water disposal equipment

- Individual well site compression

- Individual well site liquids recovery units

- Electrical power lines

- Gas metering stations

- Pipeline pigging facilities

- Field storage buildings

- Cathodic protection facilities

The number and location of such facilities are unknown at this time but most will be installed within the boundaries of existing or approved disturbances and would be subjected to appropriate environmental analysis once proposed.

Approval of the Proposed Action is Conditional upon the Following:

- Implementation of the measures found in Appendix B project-wide mitigation.

- Implementation of the additional migration measures described in Appendix C.

- Adherence to any additional conditions of approval attached to the approved APD.

- Adherence to oil and gas leases and ROW grant stipulations.

RATIONALE FOR DECISION

The decision to approve the Proposed Action is based on the following: 1) consistency with resource management plan and land use plan; 2) national policy; 3) agency statutory requirements; 4) relevant resource and economic issues; 5) application of measures to avoid or minimize environmental impacts; 6) finding of no significant impact; 7) public comments

1. Consistency with Resource Management Plan and Land Use Plan

The Proposed Action is in conformance with the intent, meaning and scope of the Green River Resource Management Plan (RMP). The objectives for oil and gas management is to "provide consideration for oil and gas leasing, exploration, and development of oil and gas while protecting other values." The objective of the realty program is to "manage the public lands to support the goals and objectives of other resource programs" and "to respond to public demand for land use authorization." All public lands affected by the proposal are leased for oil and gas with appropriate mitigation including the requirement for an acceptable plan of which the criteria can be found in Appendix B and C of this decision record.

2. National Policy

Private exploration and development of federal oil and gas leases is an integral part of the BLM oil and gas leasing program under the authority of Mineral Leasing Act of 1920, as amended and the Federal Land Policy and Management Act of 1976, as amended. The United States continues to rely heavily on foreign energy sources. Oil and gas leasing is needed to encourage development of domestic oil and gas reserves to reduce the United States' dependence of foreign energy supplies. The BLM oil and gas program is designed to encourage such development. Therefore, the decision is consistent with national policy.

3. Agency Statutory Requirements

The decision is consistent with all federal, state, and county authorizing actions required to implement the Proposed Action. All pertinent statutory requirements applicable to this proposal were considered including informal consultation and formal conferencing with the U.S. Fish and Wildlife Service (USFWS). Cultural surveys and compliance with Section 106 of the Historic Preservation Act will be completed prior to approval of permits for individual components.

4. Relevant Resource and Economic Issues

Potential environmental impacts from the Pacific Rim Project proposal to surface and subsurface resources identified in the Environmental Assessment are considered minor and all deemed acceptable with mitigation identified in Appendices B and C of this decision record. The economic benefits derived from the implementation of the Proposed Action in the form of continuing employment opportunities, equipment, services, and potential revenues should production are considered important.

5. Application of Measures to Avoid or Minimize Environmental Impacts

Federal environmental protection laws, such as *the Clean Air Act*, *Clean Water Act*, and the *Historic Preservation Act*, apply to all lands and are included as part of the standard oil and gas lease terms and the terms and conditions of rights-of-way grants. The adoption of the measures identified in Chapter 2.0 and 4.0 of the project EA and contained in this Decision Record in Appendices B and C provide practicable means to avoid or minimize potential environmental impacts. Should conditions warrant, additional measures could be applied to individual permits or ROW subject to additional analysis.

6. Finding of No Significant Impact

Based upon the analysis contained in the Environmental Assessment for the Pacific Rim Shallow Gas Exploration and Development Project and with the implementation of the protection measures identified in Appendix B of this decision, I have determined that the proposed action will not cause any significant impacts on the human, natural, and physical environment. Therefore, an environmental impact statement is not required.

7. Opportunity for Public Involvement

BLM initiated public scoping on October 17, 2003. Fifteen (15) comments were received in response to the EA during the 30-day comment period that ended November 17, 2003. All issues, concerns, and alternatives brought forth during public scoping have been considered during the analysis. The following is a list of those responding to the request for public comment.

- Dave Welch
- Roy Reynolds
- Lee Kreutzer
- Gene George
- Mark Kot
- John D. Pallensen
- Fish and Wildlife Service
- Petroleum Association of Wyoming
- Biodiversity Conservation Alliance
- National Wildlife Federation
- State of Wyoming
  - Department of Environmental Quality
  - State of Historic Preservation Office
  - State Engineer's Office

Office of State Lands and Investments
Wyoming Game and Fish Department

A summary of the substantive comments and the BLM's response to comments are found in Appendix A.

APPEAL

Under BLM regulation, this decision is subject to administrative review in accordance with 43 CFR 3165. Any request for administrative review of this decision must include the information required under 43 CFR 3165.3(b) including all supporting documentation. Such a request must be filed in writing with the State Director (920), Bureau of Land Management, P.O. Box 1828, Cheyenne, Wyoming 82003, within 20 business days of the date such notice of decision was received or considered to have been received. This decision will be considered to have been received seven (7) business days from the date it is mailed.

The decision of the State Director could be appealed to the Interior Board of Land Appeals in accordance with the regulations contained in 43 CFR 3165.4 and 43 CFR 4. Each adverse party to any such appeal must be provided with all documentation in accordance with 43 CFR 4.413(a). The adverse party to any appeal of the decision by the State Director includes:

Scott Hedlund
Warren E&P
123 West First Street, Suite 505
Casper, Wyoming 8201

SIGNATURE

Michael R Hallett
Rock Springs Field Manager

9/1/2004
Date

FINDING OF NO SIGNIFICANT IMPACT
PACIFIC RIM SHALLOW GAS
EXPLORATION AND DEVELOPMENT PROJECT

Based on my review of the analysis in the Pacific Rim Shallow Gas Exploration and Development Project Environmental Assessment (EA), I have determined that the Proposed Action is in conformance with the approved land use plan and will not have any significant impact on the human, natural, and physical environment. Therefore, an environmental impact statement is not required.

The EA shows that adverse impacts to surface ownership/land use and grazing; socioeconomics/environmental justice; cultural resources; soils/watershed; water resources; geology/minerals/paleontology/; air quality/noise; vegetation/wetlands/noxious weeds; wildlife/fisheries; threatened, endangered, candidate, and special status species; wild horses; visual resources; transportation; and from the use of hazardous materials would all be minor, short term, necessary and due impacts. Potentially, substantial positive economic impacts could result for the company, and local, state, and federal governments.

The Green River Resource Management Plan (GRRMP) provides for the use of these public lands for natural shallow gas exploration and drilling such as this. The Proposed Action would be in conformance with these land use plans, and no amendments to our RMP would be necessary to implement the Proposed Action.

Michael R Hallett
Rock Springs Field Manager

9/1/2004
Date

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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
AJE	annual job equivalents
analysis area	Pacific Rim Project Area
ANC	Acid Neutralizing Capacity
AO	authorized officer
APD	Application for Permit to Drill
APE	area of potential effect
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	U.S. Army Corps of Engineers
CREG	Consensus Revenue Estimating Group
CRO	Cultural Records Office
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
EO	Executive Order
EPA	Environmental Protection Agency

ABBREVIATIONS/ACRONYMS

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
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
KMDA	Known Mineral Deposit Area
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
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
PRPA	Pacific Rim Project Area
PRU	Pacific Rim Unit
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
REL	Reference Exposure Level
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
RUA	Recreation Use Area

RV	recreational vehicle
SAR	Sodium Absorption Ratio
SARA	Superfund Amendments and Reauthorization Act
scf	standard cubic feet
SCR	Sweetwater County Road
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
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
WAAQS	Wyoming Ambient Air Quality Standards
Warren	Warren E & P, Inc.
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
μeq/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

Warren E & P, Inc. (Warren) has notified the Bureau of Land Management (BLM), Rock Springs Field Office (RSFO) that Warren proposes to explore and potentially develop a shallow gas project located within the administrative boundary of the BLM Rock Springs Field Office. The proposed Pacific Rim Shallow Gas Project area (PRPA) is generally located in Townships 13, 14 and 15 North, and Ranges 100 through 101 West, 6th Principal Meridian, Sweetwater County, Wyoming (see Figure 1-1). The shallow gas wells, access roads, pipelines, power lines and compression 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.

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 explore for and develop shallow gas within the project area. The Proposed Action would allow the lease holders to exercise their existing rights to drill for, extract, remove, and market gas products if exploration proves successful. Ancillary facilities such as compression facilities and power lines 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

The total project area encompasses 47,597.82 acres of land, more or less, of which approximately: **(1)** 41,738.60 acres are federal surface and minerals; **(2)** 1,319.38 acres are State of Wyoming surface and minerals; **(3)** 640 acres are State of Wyoming surface and federal minerals; **(4)** 640 acres are private surface and federal minerals; and **(5)** 3,259.84 acres are private surface and minerals. Existing access to the area consists of Wyoming Highway 430, Sweetwater County Road No. 24, and other existing or newly constructed roads.

The Pacific Rim Project overlies an area mostly unexplored for natural gas. Since 1954, one (1) producing well has been drilled and developed, twelve (12) natural gas wells have been drilled and shut in, and fifteen (15) non-producing wells have been drilled, plugged, and abandoned (WOGCC website 5/14/04).

Warren proposes exploratory drilling and potentially producing a maximum of 120 wells on 160-acre spacing. Drilling is expected to last approximately two to four years, with a projected life-of-project (LOP) of 10 to 20 years. Wells would target sandstone reservoirs and coal seams within the Almond Formation at depths of 1,000 to 6,500 feet. Gas produced would be from both coal seams (coalbed methane (CBM)) and adjacent sands. In addition to wellpads and associated construction, Warren anticipates that additional infrastructure such as access roads, compression facilities, and pipelines would be necessary to develop this resource. Additional gas volumes would be transported via existing trunk pipelines, but additional gathering and transmission pipelines are anticipated, depending on the drilling success. The Proposed Action is discussed in-depth in Chapter 2, Proposed Action and Alternatives.

The PRPA is located southeast of Rock Springs as shown on Figure 1-1, and contains federal, state, and private surface and minerals ownership. Total surface and mineral land areas and status are shown in Table 1-1.

Table 1-1. Surface and Mineral Ownership of the Pacific Rim Project Area.

Ownership	Surface Acres	Surface Percent	Mineral Acres	Mineral Percent
Federal (BLM)	41,738.6	87.7	43,018.6	90.4
Private	3,899.8	8.2	3,259.8	6.8
State of Wyoming	1,959.4	4.1	1,319.4	2.8
Total	**47,597.8**	**100.0**	**47,597.8**	**100.0**

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 Green River Resource Management Plan (GRRMP), Decision Record approved 1997. The objective for management of oil and gas resources, as stated in the GRRMP, is to provide for leasing, exploration, and development of oil and gas while protecting other resource values. In addition, the GRRMP states public lands

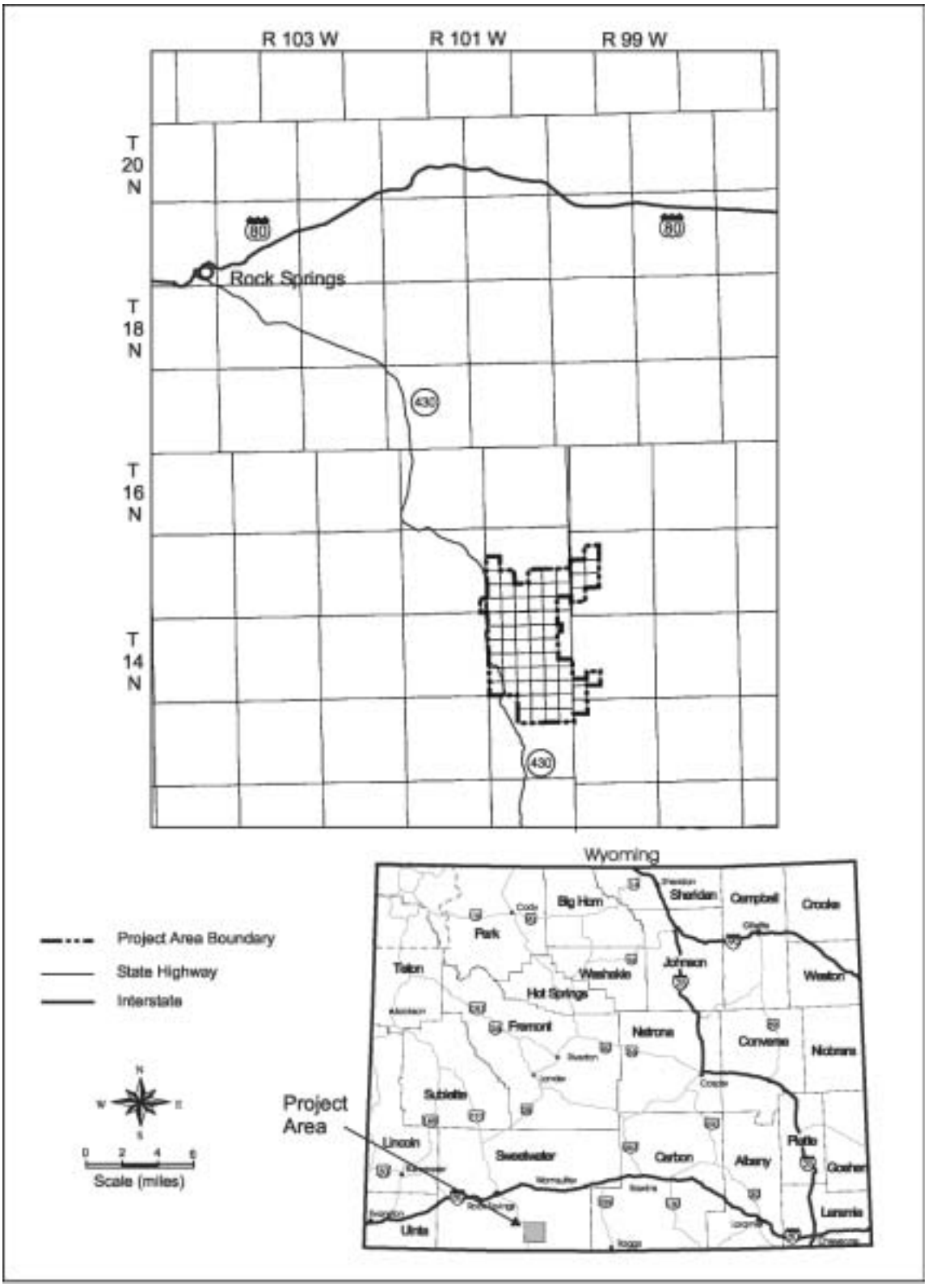


Figure 1-1. General Location Map, Pacific Rim Shallow Gas Project, Sweetwater County, Wyoming

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 Pacific Rim Unit is in conformance with the GRRMP. The reasonably foreseeable development analyzed in the GRRMP 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 Pacific Rim Unit would incorporate decisions, terms, and conditions of use as described in the GRRMP. 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 PRPA 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 PRPA 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 analyzes directional and horizontal drilling techniques in the Almond formation.

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 (CEQ) 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;
- It 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 Pacific Rim Shallow Gas 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. This EA 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.

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 used for identifying the significant issues related to a proposal. In compliance with this procedural requirement, the RSFO BLM released a scoping notice on October 16, 2003 for a 30-day review period. Fifteen 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, water discharge 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 Pacific Rim project area.
- Potential conflicts between mineral development activities and recreational opportunities.
- Application and acquisition of appropriate permits.
- Potential impacts to sensitive plant species, including Nelson's milkvetch and Wyoming Tansymustard.
- Potential impacts to Special Status Species or species at risk, including Black-footed ferret, Ute ladies'-tresses, Yellow-billed Cuckoo, migratory birds, and Mountain plover.
- Potential impacts with known paleontological sites.
- Potential impacts to roadless lands proposed for wilderness status.

Certain issues were determined to not be "adverse 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:

- 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 in excess of 1,500 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 1,500 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 Pacific Rim 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 ALTERNATIVE DEVELOPMENT PROCESS

Warren is proposing to drill 120 shallow gas wells for both technical and economic reasons. Of the 120 wells, 108 would be located on public lands managed by the BLM, 8 would be located on private lands, and 4 would be located on State of Wyoming lands. The 120 wells were determined by Warren to be the minimum number necessary to implement this project and 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 1,000 feet to 6,500 feet. Additionally, 120 wells provides flexibility in repositioning a pod or group of wells in the event that the exploratory drilling attempts encounter poor quality reservoirs or indicate a need to drill future wells on denser spacing. The 120-well proposal also provides a sufficient number of wells to effectively dewater the target reservoirs.

The proposed gas development is based on a 160-acre well spacing pattern. In addition to well sites, other reasonable and necessary facilities (such as access roads, gas gathering and water disposal pipelines, electrical utilities, and compressors) would be developed to facilitate natural gas production in the Pacific Rim Shallow Gas Project Area (PRPA). The project would be developed over a 2- to 4-year period. The projected life-of-project is estimated to be between 10 and 20 years.

Based on the planning information provided by Warren, this EA addresses Warren's Proposed Action and the No Action Alternative.

2.1 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

Horizontal or directional drilling might allow the clustering of surface facilities; however, this alternative has not been given further consideration for the following reasons:

- Economics. Horizontally drilled wells are estimated to cost 1.5 to 10 times as much as similar vertically drilled wells with no commensurate increase in production. This is due to the requirement of drilling as many laterals to develop the gas resource in a formation as there are coal seams. In addition, horizontal laterals would not be economical in thin coal seams because the cost of each lateral would exceed the return on ultimate gas recovery. In conventional drilling, thin coal seams will contribute to overall production; therefore maximizing recovery of the gas resource.

- Reservoir Issues. The science of coalbed methane gas wells does not warrant drilling horizontal wells for the purpose of intersecting naturally occurring vertical fractures. The coal seams of the Almond Coal formation contain several seams ranging in thickness from 1 to 10 feet. Some Almond coal seams may correlate between wells over long distances, but there are 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 seams locations, directional or horizontal drilling will not produce the desired results.

2.2 PROPOSED ACTION

The Warren E & P, Inc. (Warren) Proposed Action consists of exploratory drilling with potential drilling, completing, and operating a maximum of 120 shallow gas wells and related production and water disposal facilities in the PRPA (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 possibility exists that Warren would abandon the proposal

2.2.1 Preconstruction Planning and Site Layout

- Warren would follow the procedures outlined below to obtain approval for proposed activities on BLM administered lands within the PRPA. Additional site-specific environmental analyses and resource information will be contained in the individual well Applications for Permit to Drill (APD) and/or Right-of-Way (ROW) applications when submitted to the BLM. Development activities proposed on private or State of Wyoming surface would be submitted to and approved by the Wyoming Oil and Gas Conservation Commission (WOGCC). The WOGCC permitting procedures require filing an APD with the WOGCC and obtaining a ROW from the surface owner. Warren bases this proposed activity on preliminary development plans previously submitted to the BLM in 2003.

  Prior to the start of construction activities, Warren would submit a Notice of Staking (NOS), APD, or ROW Application to the BLM with a map showing the specific location of the proposed activities, such as individual drill sites, pipeline corridors, access roads, or other facilities. The application would include site-specific plans where necessary to describe the proposed development (i.e., drilling plans with casing/cementing program; surface use plans with road and drill pad construction details; and site specific reclamation plans, etc.). Approval of all planned operations would be obtained in accordance with the authority prescribed in Onshore Oil and Gas Order No. 1 (Approval of Operations on Onshore Federal and Indian Oil and Gas Leases).

- The proposed facility would be staked by Warren and inspected by an interdisciplinary team and/or an official from the BLM to ensure consistency with the approved Green River Resource Management Plan (GRRMP), approved mitigation measures incorporated into the PRPA (FONSI/Decision Record), and plans provided by Warren in the APD or ROW Application. If or when required by the BLM for the proposed development, more detailed construction plans would be submitted by Warren. Such plans would address concerns that may exist regarding construction standards, required mitigation, or related matters. Negotiation of these plans between Warren and the BLM,

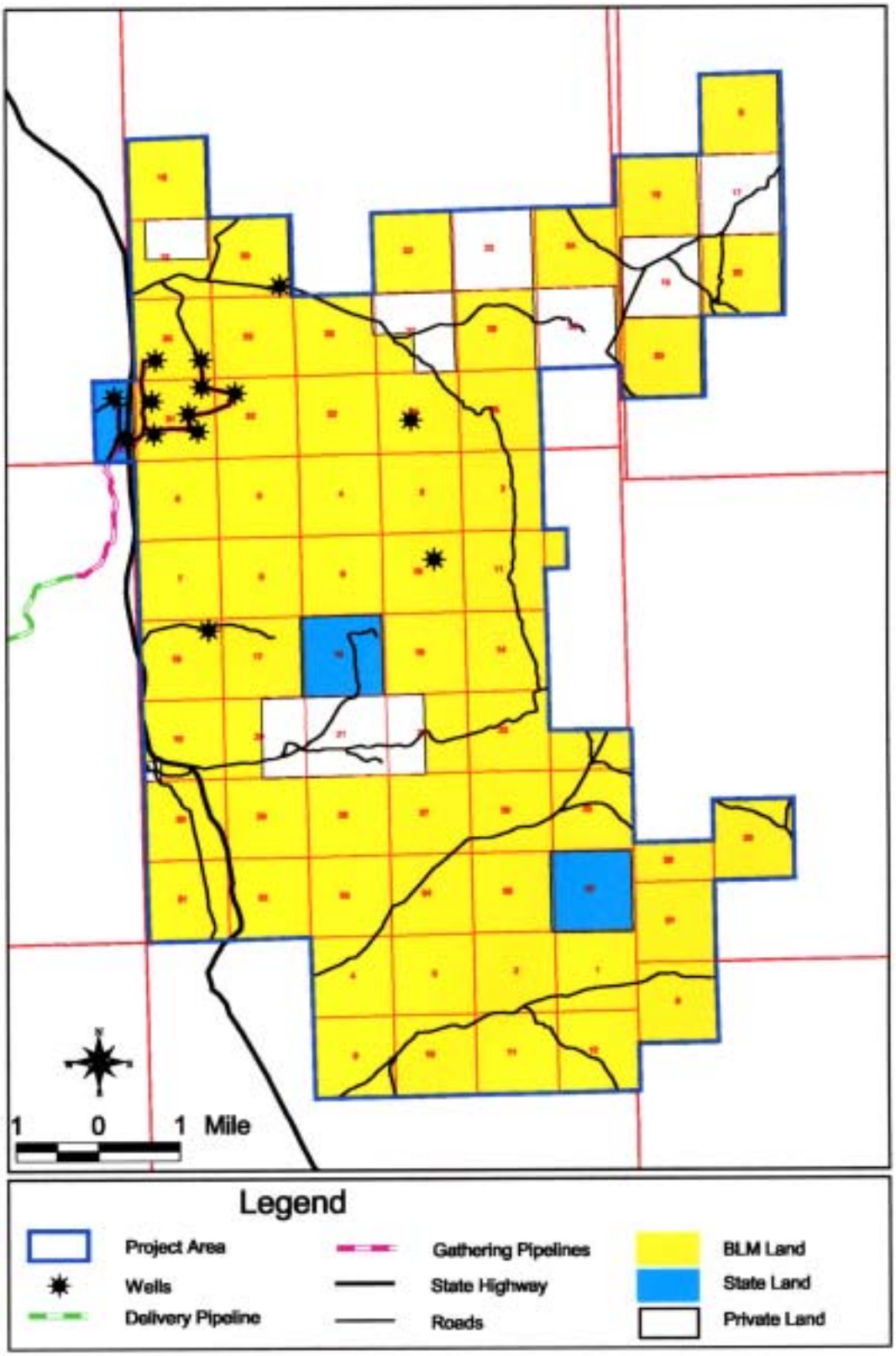


Figure 2-1. Pacific Rim Project Area Showing Surface Ownership.

if necessary to resolve differences, would be based on field inspection findings resulting from BLM on-site inspections.

- Warren and/or its contractors would make any necessary revisions to the APD or ROW Application based on negotiations with the BLM. The BLM would complete a project-specific environmental analysis that incorporates agreed upon construction and mitigation standards. The BLM would then approve the specific proposal and attach the Conditions of Approval to the permit. Warren would then commence the proposed activity within one year after the BLM's approval date.

A general discussion of proposed construction techniques to be used by Warren is set forth below. These construction techniques would apply to drill site, pipeline, and access road proposals within the PRPA, and may vary between the well sites.

2.2.2 Construction and Drilling Phase

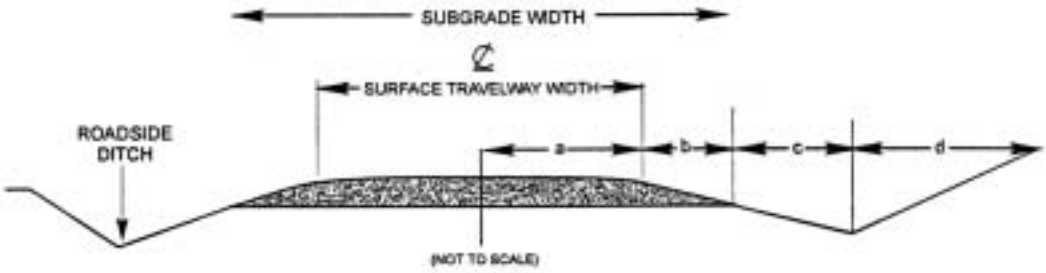
2.2.2.1 Road Construction

The primary roads utilized by Warren to access the PRPA would be Wyoming State Highway (WYO) 430, Sweetwater County Road (SCR) 19, SCR 24 and SCR 76. These existing improved roads represent approximately 40 percent of the access road network proposed for the PRPA. There would be no authorized use of unimproved roads to access wells. Where possible, existing 2-track trails intersecting or parallel to new access roads would be reclaimed in order to minimize or reduce surface disturbance. All roads leading to producing wells will be graveled.

Where required, Warren proposes to construct new access roads across public lands in accordance with Wyoming State Office (WSO) BLM Manual 9113 Supplement (see Figure 2-2). All roads leading to producing wells would be graveled. As stated in WSO BLM Manual 9113 Supplement, "Flat-bladed roads will not be authorized in Wyoming. In most cases, flat-bladed roads develop into canals and are a hazard to users as well as creating environmental resource damage, especially on sensitive soils." Roads would be located to minimize disturbances and maximize transportation efficiency, and would be closed and reclaimed by Warren when they are no longer required for production operations, unless otherwise directed by the BLM. Roads would be designed to minimize disturbance and would be built and maintained to provide safe operating conditions for the specific purpose of natural gas field development. Surface disturbance would be contained within the road right-of-way (ROW). Roads located on private lands would be constructed in accordance with standards imposed by the private landowner.

Development of the 120 wells would require the construction or reconstruction of approximately 35.64 miles of access roads and approximately 35.64 miles of gas and produced water gathering lines (facilities corridors). It is estimated that 32.1 miles of new roads would be built on federal land and 3.5 miles of roads or facilities corridors would be built on private and state land.

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 Warren or its agents.



	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	48	55	20-50
Collector Road	28	24	12	2	4	8	52	60	30-50

DIAGRAM OF TYPICAL TURNOUTS ON RESOURCE ROADS (PLAN VIEW)

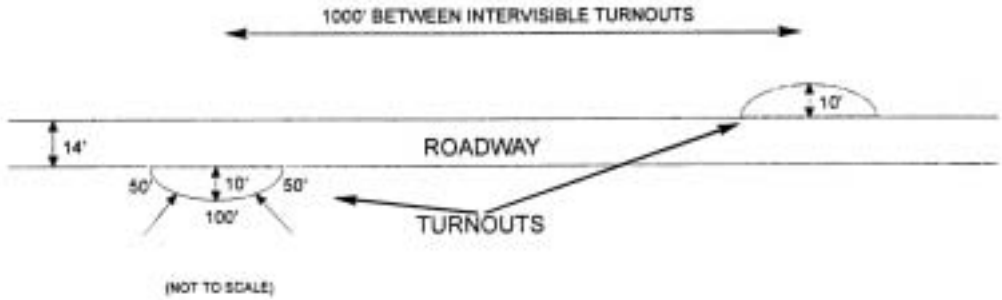


Figure 2-2. Typical Roadway Cross-Section with Width Specifications.

Topsoil on new road ROWs would be salvaged, spread on the backslope of the borrow ditch within road ROWs, and seeded to prevent erosion as necessary. Windrows of topsoil will not be left above the borrow ditch. Available topsoil (up to 12 inches) would be: (1) stripped from all road corridors prior to commencement of construction activities, (2) stockpiled, and (3) redistributed and reseed using authorized seedmix by BLM 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 within one (1) year of well plugging using stockpiled topsoil and appropriate seeding techniques. Any rocks that were encountered 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 Gas Wells	108	8	4	120		108	8	4	120
Number of disposal wells	10	0	0	10		10	0	0	10
Gas Well Pads[1]	21.6	1.6	.8	24		118.8	8.8	4.4	132
Disposal Well Pads[2]	9.2	0	0	9.2		12.4	0	0	12.4
Roads[3]	103.7	7.7	3.9	115.3		129.6	9.6	4.8	144
Compressors(5)	4.5	0	0	4.5		4.5	0	0	4.5
Gathering Pipelines [4]	0	0	0	0		129.6	9.6	4.8	144
Delivery Pipelines[5]	0	0	0	0		60.6	0	0	60.6
Total	**138.1**	**9.3**	**4.7**	**153.0**		**455.5**	**28**	**14**	**497.5**

[1]Assumes initial disturbance of approximately 1.1 acres for each well pad and LOP disturbance of 0.2 acre per well pad.
[2]Assumes initial disturbance of approximately 1.2 acres per well pad and LOP disturbance of 0.9 acres per well pad.
[3]Assumes an average of 0.33 mi of new roads with a 30-ft average disturbance width for each well. All disturbance except for the estimated 14-ft wide road travelway and adjacent ditches would be reclaimed for the LOP.
[4]Assumes an average of 0.33 mi of new gas gathering and water discharge lines with a 30-ft average disturbance width for each well. All disturbance will be reclaimed for the LOP.
[5]Assumes an average disturbance width of 50 ft. All disturbance will be reclaimed for the LOP.

2.2.2.2 Well Pad Design and Construction

The majority of the proposed gas wells would be drilled on lands administered by the BLM. A graded well pad would be constructed at each well site, and drilling operations should not disturb an area greater than approximately 180 feet by 270 feet at each well site.

Cut and fill construction techniques would be used within the well site area to level and clear the well pad of vegetation. (See Figure 2-3 for a typical CBM drill site layout).

A temporary reserve pit 55 feet wide, 10 feet deep, and 75 feet long would be excavated at each well and reclaimed after completion of operations. The reserve pits would be lined with an impermeable liner. Topsoil would be removed and stockpiled prior to excavating the pit as required by BLM. Warren estimates that reserve pits would be open for a period of approximately 2 to 8 weeks to allow for evaporation of pit fluids. During this time, the pits would be fenced on all sides to prohibit wildlife and livestock from falling into the pits.

In the event drilling is non-productive, all disturbed areas, including the well site and access road, would be reclaimed to the approximate land form that existed prior to construction. Reclamation would take place within one (1) year of plugging. Reclamation and site stabilization techniques would be applied as specified in the APD Surface Use Plan or the Right-of-Way Plan of Development (POD).

If drilling is productive, all access roads to the well site would remain in place for well servicing activities (i.e., maintenance, improvements, etc.). Partial reclamation would be completed on those segments of the well pad and access road that are no longer needed.

2.2.2.3 Drilling and Completion Operations

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. Wells would be drilled to sandstone reservoirs and coal seams within the Almond Formation at depths of approximately 1,000 feet to 6,500 feet. The Almond Formation is presently proposed for initial exploration, but other sandstone and coal reservoirs may be explored. Gas produced would be from both coal seams (coalbed methane (CBM)) and adjacent sands. The CBM wells would be drilled through the Lance, Lewis Shale, Almond, and Ericson Formations, stopping at the top of the Rock Springs Formation. The Ft. Union may appear in the southern portion of the project area. Water for use in drilling the wells would be obtained from properly permitted sources near the project area, from wells previously drilled in the project area, or from a commercial source in Rock Springs, Wyoming. Water used to drill one well may also be reused for drilling subsequent wells. Approximately 4,500 barrels of water would be needed for drilling and completing each well; however, actual water volumes would be dependent upon the depth of the well and any losses that might occur during drilling and completion operations.

Well control systems would be designed to meet the conditions likely to be encountered in the hole and would be in conformance with Federal Onshore Order No. 2 and State of Wyoming requirements. A completed shallow gas well bore is shown on Figure 2-4.

Drilling and completion operations for a gas well normally require approximately 10 to 15 people at a time, including personnel for logging and cementing activities. Each well would be drilled,

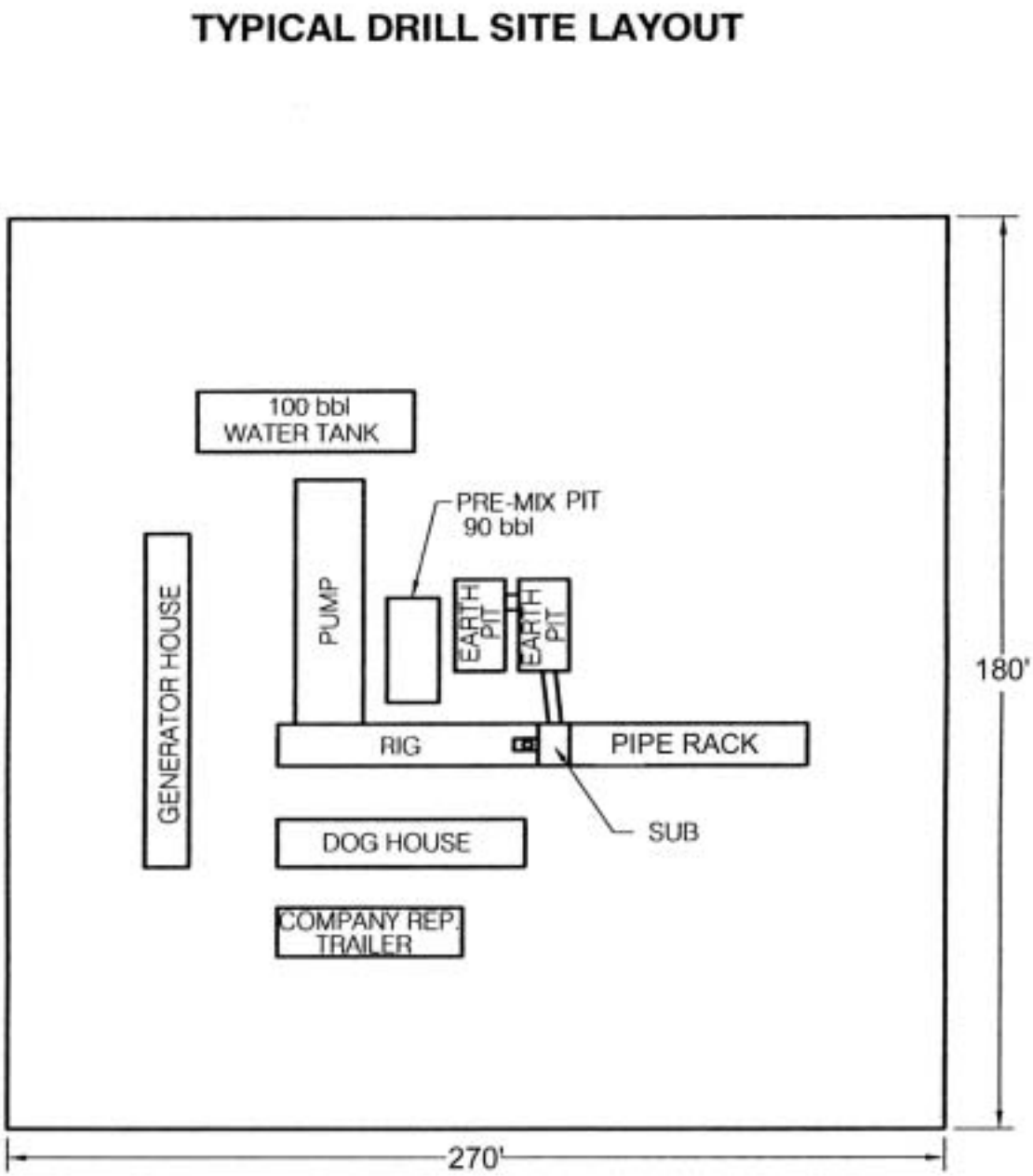


Figure 2-3. Typical CBM Drill Site Layout

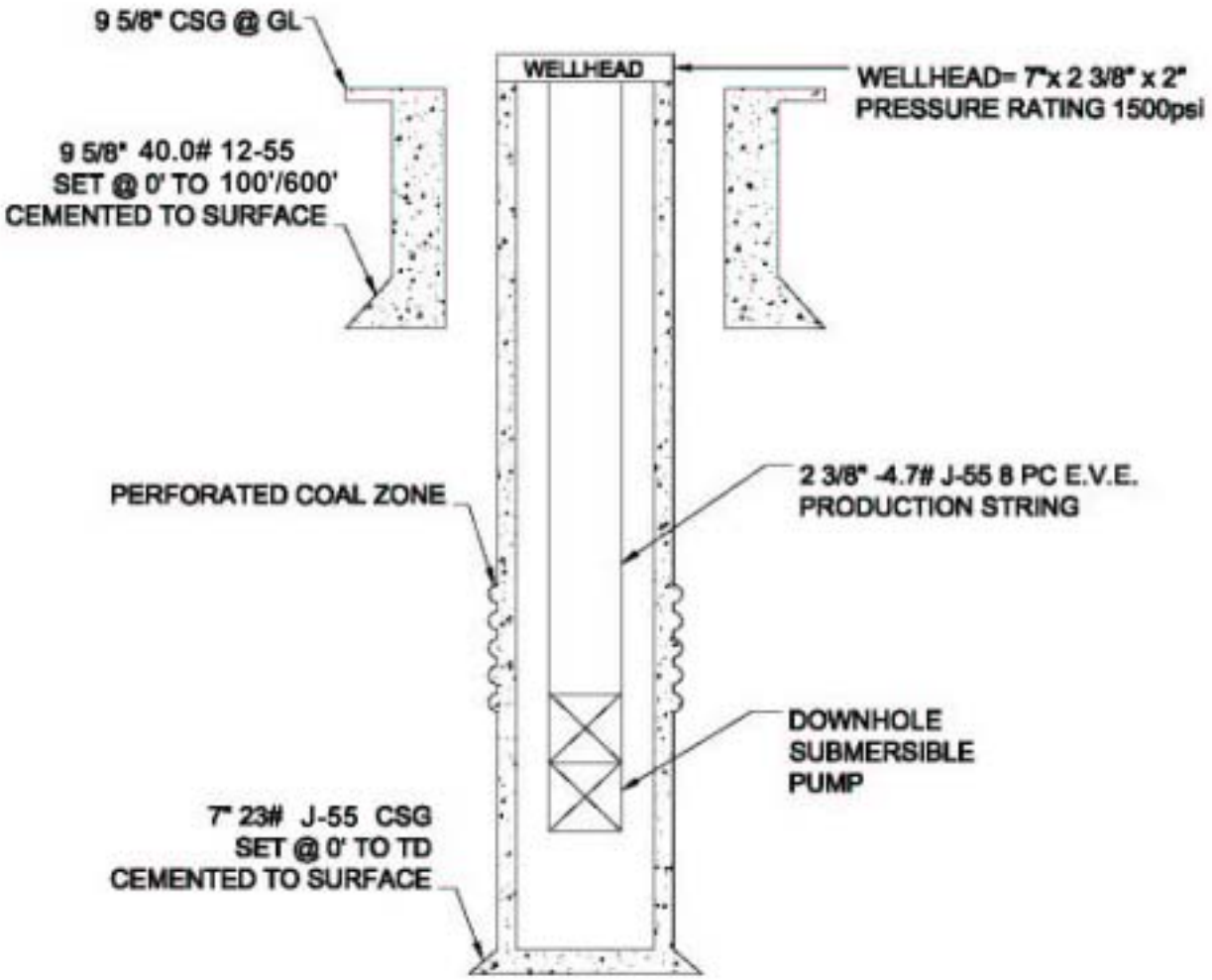


Figure 2-4. Typical Completed Shallow Gas Well Bore.

logged and cased within a period of 5 to 10 days. A well completion program may be initiated to stimulate production of gas and to determine gas and water production characteristics. Gas may be vented for a short period of time during testing to determine if a well is capable of production. Produced water will not be discharged onto surface areas within the project. Productive wells will be shut-in until pipelines and other production facilities can be constructed.

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 of disposal wells would be accomplished with the equipment and personnel used to drill the gas wells. Depths of the disposal wells are expected to range from 3,000 feet to 7,500 feet. Drilling and completion of a disposal well is expected to take approximately 12 to 15 days, and installation of surface equipment, holding tanks and pumping equipment would include an additional 14 days. A schematic of a typical injection well is shown on Figure 2-5.

Fresh-water aquifers would be protected by running casing into the open borehole and cementing the casing into place. Cementing would also isolate all other formations in the hole and will effectively eliminate the possibility of contamination between hydrocarbon zones, water aquifers and other mineral resources.

During drilling and subsequent operations, all equipment and vehicles will be confined to access roads, well locations and other areas specified in the approved APD's, except in emergency situations.

2.2.3 Well Production Facilities

Wellhead facilities would be installed if the gas wells are productive, and a weatherproof covering would be placed over the wellhead facilities. At this time, no additional facilities would be constructed at the well site for the separation of gas and water. A downhole pump would be utilized to produce water from the cased hole or perforated interval. Gas would flow to the surface using the space between the production casing and the water tubing. The long-term surface disturbance (10 to 20 years) at each productive well location would encompass approximately 0.2 acres. Well site production facilities will be fenced or otherwise removed from existing uses.

Pipeline trenches for well gathering lines are expected to temporarily disturb portions of a 30-foot wide corridor and would be reclaimed as soon as practical after construction is completed.

Trenches will be constructed along the access roads wherever feasible. Gathering lines would be buried in the trenches and will transport gas to compression facilities and produced water to disposal facilities.

At the conclusion of the project, roads, culverts, cattleguards, pipelines, stock watering facilities, or other structures may be left in place for any beneficial use designated by the BLM or surface owner. Water wells and produced water would be available for use by the BLM, so long as appropriations, diversions, and storage rights are properly filed with the Wyoming State Engineer's Office. All federally-owned surfaces that contain disturbed areas or facilities that are no longer needed would be reclaimed.

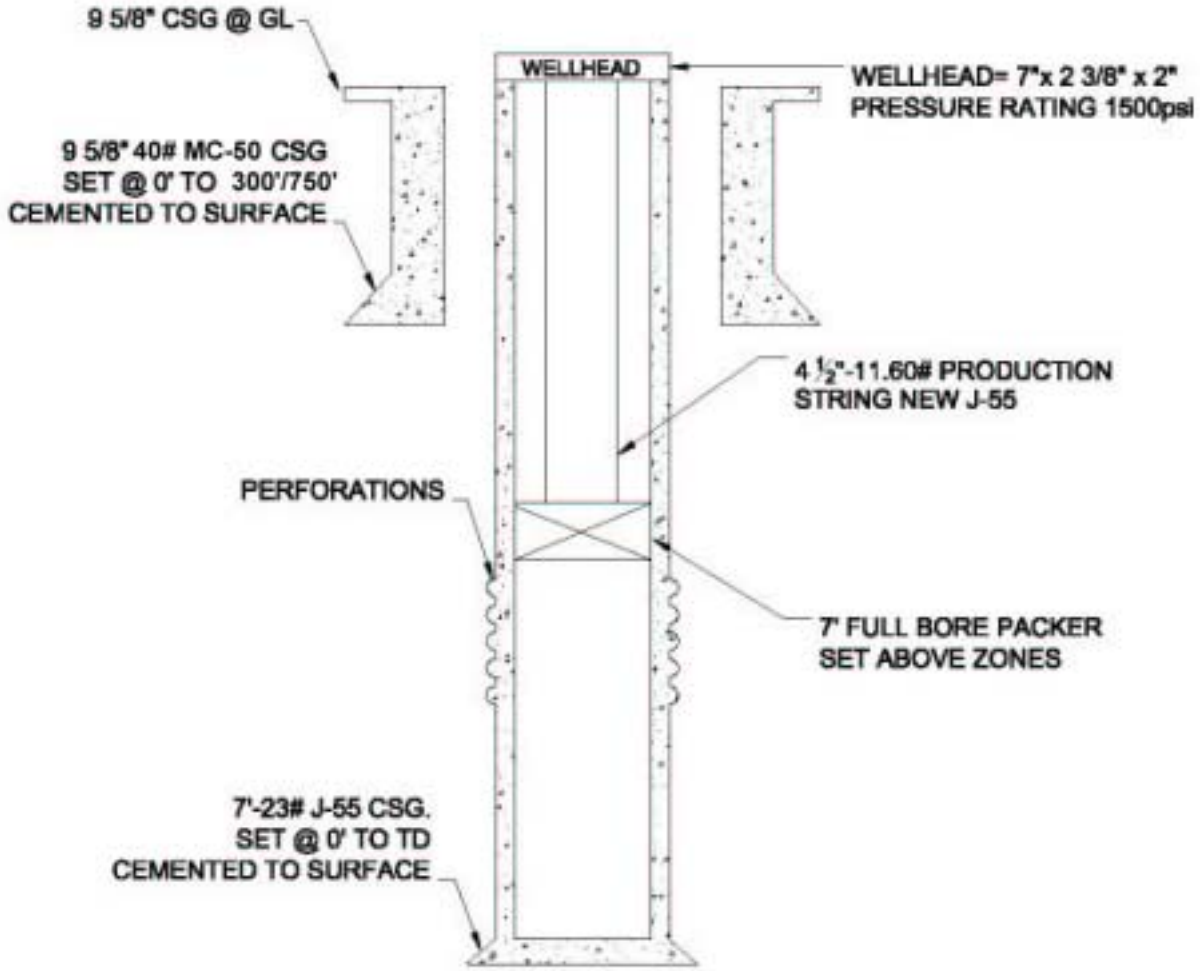


Figure 2-5. Typical Water Injection Well Bore

2.2.4 Electric Power Construction

Electricity would be used to power pumps during well development and to initiate and maintain production. Natural gas-fired generators would be used until electrical distribution lines are constructed. Temporary generators would be located on well sites or within compressor stations to minimize surface disturbance.

Permanent electricity would be supplied from an electric utility substation or high voltage line into the PRPA. The 15kV power line would be constructed overhead using standard overhead power line construction techniques in conformance with the National Electric Safety Code (NESC), the American National Standards Institute, and *Mitigation Collisions with Power Lines: The State of the Art in 1996* (Avian Power Line Interaction Committee 1996) or any future updated versions.

Removal of vegetation would be minimized for setting of poles. Prior to construction, all resource protocols would be satisfied. Holes for pole placement would be drilled by truck mounted auger. No water is necessary for drilling. Poles would be set using a truck mounted crane or other appropriate equipment. The footings of each pole would be backfilled with drill cuttings and tamped into place to prevent structure movement or settling. Final structure assembly and hardware placement would be completed using man-lift trucks. Guy wires may be installed on specific power poles and would be located within the approved ROW. Guy wires would be screwed into the ground in accordance with standard construction practices.

Following the assembly and erection of all power pole structures, conductor and ground wires would be installed. Wire installation would involve pulling a nylon rope (leader line) and then the conductor or ground wire through temporary pulleys installed on each insulator or ground wire bracket. An all-terrain vehicle (ATV) or light truck would be used to pull the leader line from pole to pole, and a winch would be used to pull the wires. Each reel would hold 2,000 feet to 3,000 feet of wire, and all wires would be spliced where required. Once each wire is correctly positioned, the final mounting hardware would be installed, and temporary installation pulleys would be removed. Man-lift trucks, hydraulic tension machines, and reel trailers would be used to suspend and mount the conductors and ground wires.

2.2.5 Pipeline Construction

Three types of pipelines, as described below, would be constructed as part of the proposed project:

1. Gas-gathering pipeline systems (low pressure, from wellhead through trunk line to compressor station).

2. Produced water-gathering pipeline systems (low pressure, from wellhead through trunk line to disposal facility).

3. Gas-delivery pipelines (high pressure, from compressor station to existing or newly constructed transmission pipelines).

Reclamation of pipeline corridors will occur as soon as possible after pipeline construction is completed.

2.2.5.1 Gas-Gathering Pipeline Systems

As part of the transportation system, gas-gathering pipelines and produced water-gathering pipelines would be constructed, placed together in the same trench or ditch (where practical), and buried below the frost line. Construction and installation of pipelines would occur immediately after the well is determined to be productive. Pipeline rights-of-way would typically follow the access road, except in a limited number of cases where topography dictates, or as required by the BLM. Gathering lines would transport gas to production facilities and produced water to disposal wells.

Gas-gathering lines are expected to disturb portions of 30-foot wide corridors and would transport gas from each well to a trunk line and then to a compressor station. Reclamation of the pipeline corridor will occur as soon as practical after pipeline construction is completed.

Gas-delivery pipelines would convey gas from the compressor station to an existing or newly constructed transmission pipeline. Gas-delivery pipelines would be co-located with existing roads where feasible. Disturbance related to the delivery lines is expected to be confined to areas not wider than 50 feet. Production must be established before potential gas-delivery pipeline rights-of-way can be identified for site-specific environmental analysis.

Development would be constrained by the gas production from the sandstone and coal reservoirs within the Almond Formation and by the pipeline capacity available to transport compressed gas to markets.

2.2.5.2 Gas-Delivery Pipelines and Compression

Produced natural gas under wellhead pressure would move through the low pressure gas gathering system to a compressor station. Typical gathering system line pressure is less than 50 pounds per square inch (psi). Gas arriving at the compressor station would be compressed to a greater line pressure in order to facilitate the transportation and introduction of the gas into an existing transmission pipeline.

Compression of the gas at a field compressor station would increase the pressure to an estimated 400 to 1,450 psi. Warren would evaluate compression needs as wells are drilled and completed and the project develops. A compressor station would have a pad size of approximately 200 feet by 200 feet and would occupy approximately 0.9 acres of surface area. Compressors would be housed within structures and muffled to minimize noise. A typical compressor station and meter facility is shown on Figure 2-6. Warren currently estimates that five (5) compressor stations would be necessary to transport field gas to interstate pipelines: each having a maximum of 2,300 horsepower(hp) of natural-gas fired engines driving the compressors. Thus, the total maximum horsepower for the proposed development would be 11,500 hp.

2.2.6 Water Production

Long-term water production data within the project area is currently not available. Short-term tests on recently drilled gas wells indicate that discharge rates will be highly variable due to the difference in depths of the producing zones and coal thicknesses. Until long-term testing can be conducted, an average life-of-project (LOP) discharge rate of 5 gallons per minute per well has

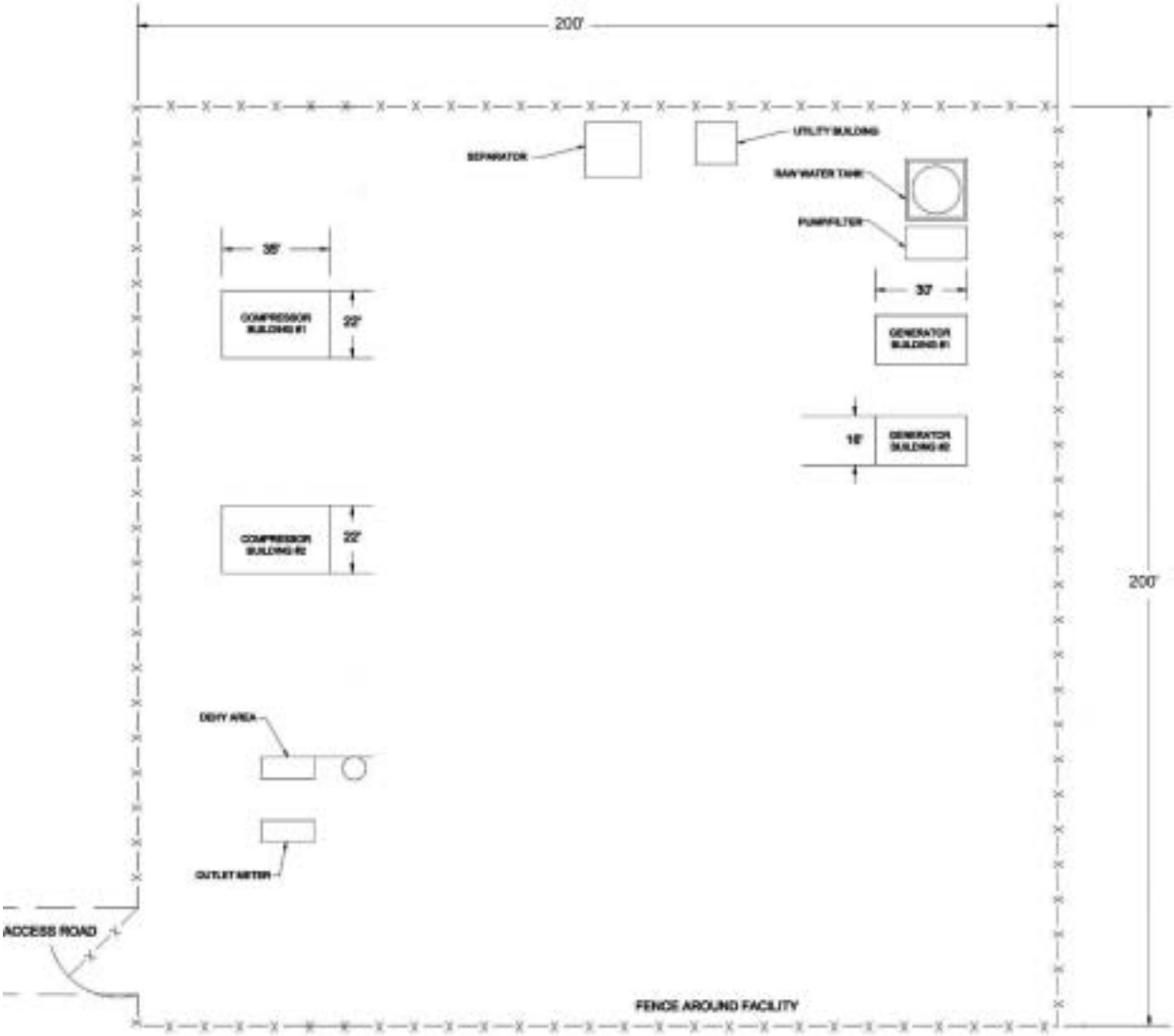


Figure 2-6. Typical Compressor Station and Meter Facility.

been assumed for this analysis. This discharge rate may vary within the project area and throughout the life of a well. Long-term average production through the life of the well is expected to be less, but in order to present a conservative analysis, the maximum rate was used for the life of the project. This rate is likely to vary from well to well; however, the maximum discharge rate should occur at the onset of production and then decline through the life of the well. Long-term average water production should not exceed an estimated 171 barrels of water per day per well.

2.2.6.1 Produced Water-Gathering System and Injection Facilities

Produced water from individual wells would be collected and re-injected in WDEQ/WQD approved and permitted disposal wells located in the project area. The water disposal wells would be drilled through the Lance, Lewis shale, Almond, Ericson, and Rock Springs Formations, stopping at the top of the Blair Formation. Water disposal would be via re-injection into the Rock Springs Formation. The water disposal formation may change if Warren does not get favorable results. All water disposal facilities would be new. The number of disposal wells would be dependent upon the ability of the designated injection zone to accept water and the amount of water produced by each gas well. Gathering lines for produced water would be constructed along the well access roads wherever feasible, and would run from the wellhead to disposal well locations. The water lines would be placed together and buried in the same trench or ditch used for gas gathering lines wherever practical in order to reduce surface disturbance. A typical water disposal facility is shown on Figure 2-7.

Transfer pumping stations would be utilized during production operations to transfer produced water from the gas well(s) to the disposal well. Transfer pumping stations would be needed in those areas where elevation differences require supplemental pumping to transfer the produced water. The location of the transfer pumping stations would be identified on the plan overview for each well. A typical transfer station would consist of two 400-barrel water tanks and a small centrifugal water pump. Each transfer station would be confined to a 125-foot by 125-foot area. A berm, approximately 3 feet tall, would be constructed around the perimeter of the transfer station area to contain any potential spills, and a small pump house would be constructed immediately outside the bermed area to house the centrifugal pump. A typical water transfer facility is shown on Figure 2-8.

As previously explained, no produced water will be discharged onto surface drainage areas within the project. The injection well method of water disposal eliminates the need for a federal water management plan, as is required in the Powder River Basin where surface discharge is the typical method of water disposal.

2.2.7 Ancillary Facilities

The Proposed Action would utilize any existing ancillary facility infrastructure within the PRPA where feasible, including access roads, water disposal facilities and gas gathering pipelines. Where existing facilities are not available, Warren would construct new ancillary facilities, which 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 exact number and location of such ancillary facilities is unknown at this time.

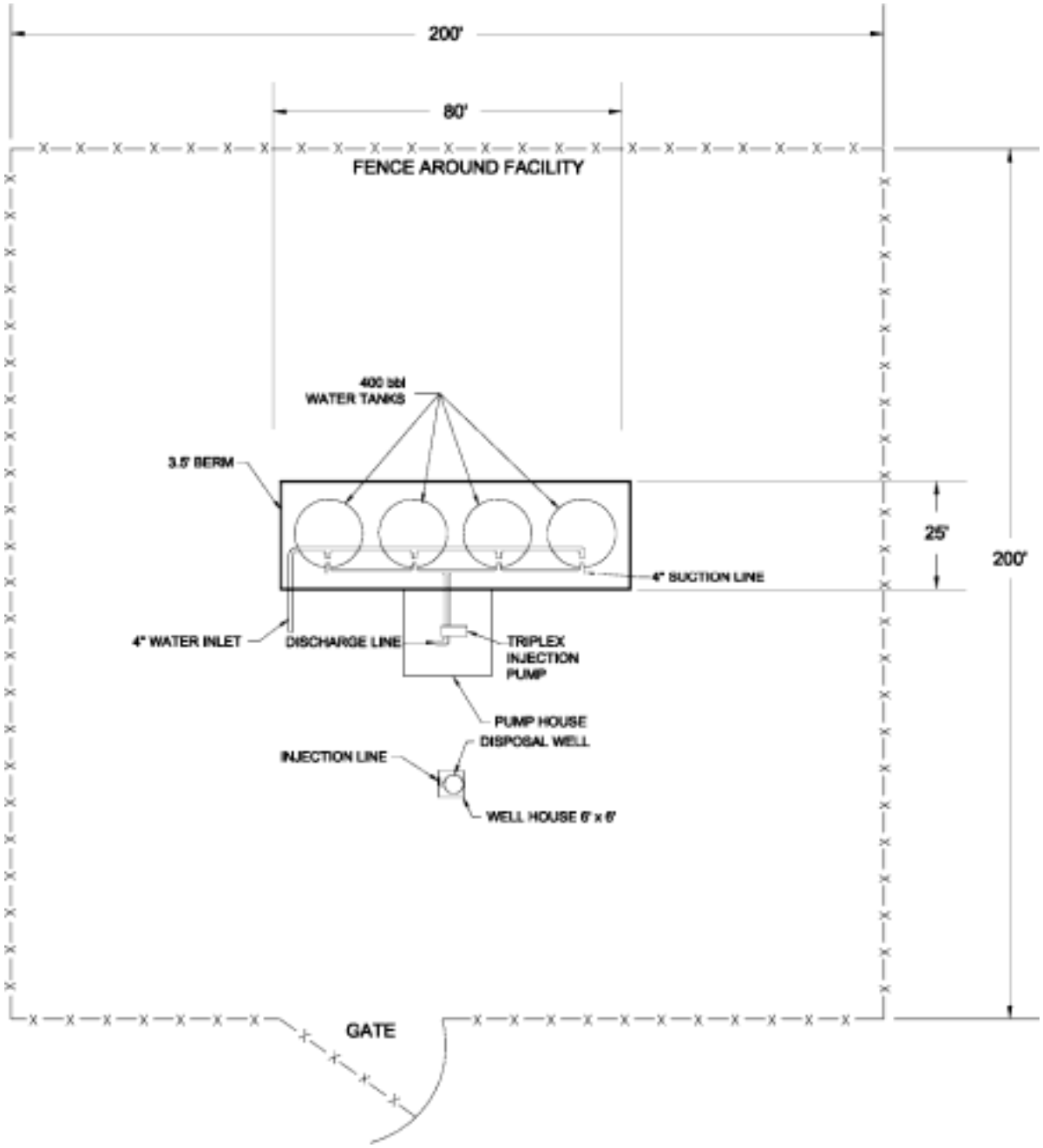


Figure 2-7. Typical Water Disposal Facility.

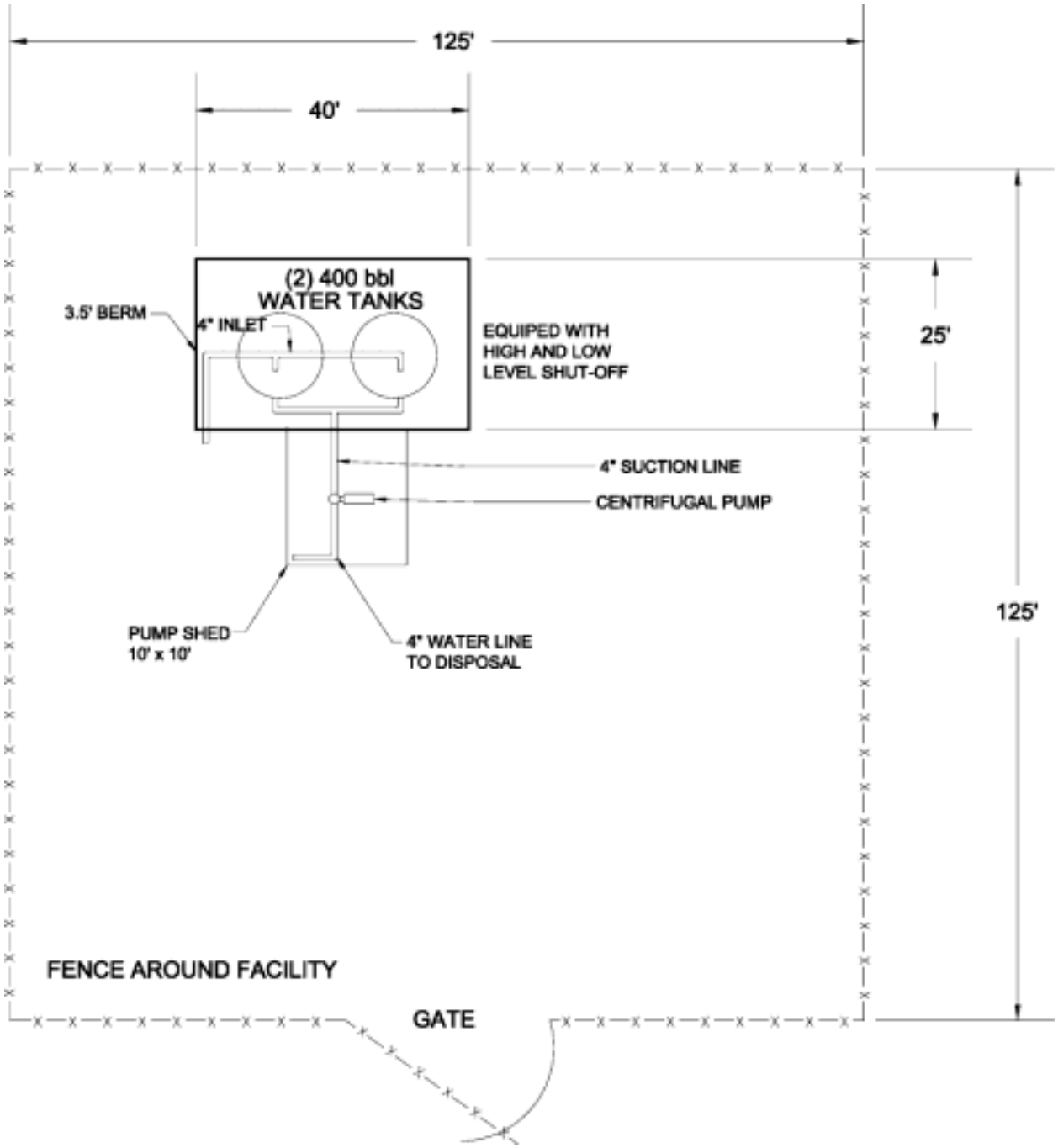


Figure 2-8. Typical Water Transfer Facility.

All wells, pipelines, and associated ancillary production facilities would be operated in a safe manner by Warren and in accordance with standard industry operating procedures. Routine maintenance of producing wells would be necessary to maximize performance and detect potential difficulties with gas production operations. Each well location would be monitored daily to ensure operations are proceeding in an efficient and safe manner, including, but not limited to: checking gauges, valves, fittings and other facilities. Routine equipment maintenance would be performed as necessary, and all roads and well locations would be regularly inspected and maintained to minimize erosion and assure safe operating conditions.

2.2.8 Geophysical Operations

No additional geophysical operations are currently planned in the project area by Warren.

2.2.9 Traffic Estimates and Work Force Loading Schedule

Estimated traffic requirements for drilling, completion, and field development operations are shown in Table 2-2. The TRIP TYPE column lists the various service and supply vehicles that would travel to and from well sites and production facilities. The ROUND TRIP FREQUENCY column lists the number of external trips (to and from the project area), and internal trips (within the project area). The figures provided in Table 2-2 should be considered general estimates. Drilling and production activity levels may vary over time due to weather and other factors.

2.2.10 Site Restoration and Abandonment

Reclamation would be conducted on all disturbed public lands in compliance with the BLM Wyoming Policy on Reclamation (USDI-BLM 1990). The short-term goal of the reclamation program is to stabilize disturbed areas as soon as possible after disturbance in order 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 and 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.

2.2.10.1 Initial Reclamation

After installation of production equipment, the well pad needed for a producing well would be reduced from approximately 1.1 acres to approximately 0.2 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 PRPA (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 Warren to assure that all disturbed areas are stabilized and that revegetation efforts are enhanced so that adverse impacts do not occur (USDI-BLM 1997, USDI-BLM 1999).

Table 2-2. Traffic Estimates per well

TRIP TYPE	ROUND TRIP FREQUENCY
Drilling	
Rig supervisor	1/day
Rig crews	2/day
Engineers(a)	1/week
Mechanics	3/week
Supply delivery(b)	1/week/project area
Water truck	1/day
Fuel trucks	1 every other day
Mud trucks(c)	1/week/project area
Rig move(d)	6 trucks
Drill bit/tool delivery	1/week
Completion	
Completion crew	1/day
Cement crew	2 trips/well
Consultant	1/day
Well loggers	3 trips/well
Gathering systems	2/day
Power systems	2/day
Compressor stations	2/day
Other field development	2/day
Testing and operations	2/day

Notes:

a. Engineers travel to project weekly and stay in a trailer during the week.
b. Current plans are to establish a central supply area and deliver supplies on a weekly basis.
c. Current plans are to establish a central mud location and deliver mud on a weekly basis.
d. Trucks are required to move each rig. Upon completion of drilling a well, each rig would move to the next well.

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 in order to promote shattering of compacted soil layers.

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 2-3 were developed from observation of successful

revegetation projects in the Green River Basin region and observation of dominant species in the project area.

Table 2-3. Bureau of Land Management Recommended Seed Mixes for Disturbed Surface Land Areas in the RSFO Management Area.

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
Slender wheatgrass		3.0-4.0
Scarlet globemallow		1.0
Gardner saltbush		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
Slender wheatgrass		3.0-4.0
TOTAL		**22.0-23.0**

[A] Pounds/acre Pure Live Seed. **(Source: USDI-PFO 1999 and Glennon 2003)**

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, as well as 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, reduce evaporation from the soil surface, and protect emerging seedlings (Majerus 1996).

BLM guidance for native seed use is BLM Manual 1745 (Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants). The Wyoming Game and Fish Department (WGFD) recommends that BLM consider shrub, forb, and grass species in seed mixtures. BLM would coordinate with the WGFD to insure that the correct shrub, forb, and grass 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.

Although not anticipated to be common in the project area, broadcast seeding may also be used, especially in areas too steep for drill seeding, or where approved by the BLM. 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 carefully selected so that the seed is lightly covered and the surface is maintained 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.

2.2.10.2 Final Reclamation/Abandonment

During final reclamation and abandonment, Warren would obtain necessary authorizations from the BLM 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 above ground 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 are summarized in Table 2-1.

2.2.11 Applicant-committed Practices

2.2.11.1 Project-Wide Mitigation Measures and Procedures

Warren proposes to implement the following mitigation measures, procedures, and management requirements on public lands administered by the BLM to avoid land use impacts. On privately owned lands, the landowner would determine which measures would be applied, to what degree, and where. Warren would coordinate with the State of Wyoming concerning 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.

2.2.11.1.1 Preconstruction Planning and Design Measures

- Warren and the BLM would make on-site interdisciplinary team inspections of each proposed and staked facility site (e.g., well sites), new access road, access road reconstruction area, 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 PRPA would be accomplished in accordance with WSO BLM Manual 9113 Supplement, unless private landowners or the State of Wyoming specify otherwise.

- Warren 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. Prior to construction, Warren or its contractors would also 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.

- Construction activities would be slope–staked when required by the BLM for steep and/or unstable slopes and BLM approval would be received prior to start of construction.

2.2.11.2 Resource-Specific Requirements

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

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

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

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

- The best known weed prevention measures, as outlined in Appendix 4 of Partners *Against Weeds: An Action Plan for the Bureau of Land Management,* would be incorporated in the mitigation requirements.

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

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

- Muddy off-road equipment would be cleaned before moving into relatively weed-free areas.

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

- Disturbed areas would be stabilized and vegetation reestablished on all bare ground using mixtures and treatment guidelines prescribed in the approved APD/ROW as soon as practical to minimize weed spread.

- Gravel, top soil and fill would be stored in relatively weed-free areas.

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

- Disturbed and re-vegetated sites would be monitored to ensure that desired species are thriving and invasive/noxious weeds are not present, and treated, reseeded and fertilized as necessary.

- Roads and other disturbed areas would be monitored throughout the life of the project

and for three years after reclamation to insure that invasive/noxious weeds are identified and eradicated.

- Warren would 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.

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

- Before treatment of invasive/noxious weeds, Warren would submit a Pesticide Use Proposal (PUP) to the BLM for approval, and 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) must be approved prior to any spraying. PUP's can be approved for up to a three year period.

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

- Pesticide Application Records would be submitted to the BLM RSFO each year. Treatments would 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.*

2.2.11.2.2 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. Warren 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).

- Warren 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.

- On Federal land, Warren 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).

- Warren would obtain the 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 WDEQ-AQD.

2.2.11.2.3 Transportation

- Existing and local roads would be used as collectors whenever possible. Standards for road design would be consistent with WSO BLM Manual 9113 Supplement. Newly constructed *Resource Roads*, spur roads that provide point access and connect to local or collector roads, would be crowned and ditched with a 14-foot wide travelway and a design speed of 30 mph.

- On Federal land, Warren 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. 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).

- 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 would be avoided where possible in planning for new roads.

2.2.11.2.4 Minerals/Paleontology

Mitigation measures presented in the Soils and Water Resources sections would avoid or minimize many of the potential impacts to the surface and mineral resources. Protection of subsurface mineral resources from adverse impacts would be provided by the BLM casing and cementing policy contained in Onshore Order No. 2.

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 PRPA in areas where construction would disturb surface exposures or subsurface bedrock of the Green River, Wasatch, and Fort Union Formations. Field surveys would involve a visual examination of the formation by a BLM-approved paleontologist in areas of exposure, and would recommend additional mitigation, if necessary. 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 any 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, scientifically-significant invertebrate or plant fossil materials from federal land without a federal permit is illegal, and that 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 Authorized Officer (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, or monitoring, and may delay resumption of work.

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

2.2.11.2.5 Soils

Other mitigation measures listed herein would also apply to Soils. The primary mitigation activities concerning Soils are as follows:

- 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 in order to avoid creating separate areas of disturbance and reduce the total area of disturbance.
- Avoid using frozen or saturated soils as construction material.
- ”Limiting disturbance on slopes greater than 25%.” (USDI-BLM, 1997, p. 159)
- 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 would not encroach within 500 feet of perennial surface water and/or riparian areas 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.

2.2.11.2.6 Water Resources

Other mitigation measures listed in the Soils, and Vegetation and Wetlands sections would also apply to Water Resources. The primary mitigation activities concerning Water Resources are as follows:

- 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.

- Surface disturbing activities would avoid the area within 500 feet of or on 100-year floodplains, wetlands, riparian areas, or perennial streams and within 100 feet of the edge of the inner gorge of intermittent and large ephemeral drainages. Proposals for linear crossings in these areas would be considered on a case-by-case basis.

- 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 replace the same or very similar bed material.

- 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 total dissolved solids 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 determine whether reinforcement and/or lining are required. If lining is required, as specified in the GRRMP (50 feet or less to ground water and permeability greater than 10^{-7} cm/hour), line the reserve pit with a reinforced synthetic liner at least 12 mils in thickness with a bursting strength of 175 x 175 pounds per inch. 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, the 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 into undisturbed vegetation.

- Develop and implement a pollution prevention plan for storm water runoff at drill sites, as required per WDEQ-WQD storm water National Pollution Discharge Elimination System permit requirements. The WDEQ-WQD 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 112), a Spill Prevention Control and Countermeasures plan would be developed in accordance with 40 CFR 112, dated December 1973.

- Coordinate all crossings or encroachments of waters of the U.S. with the 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.

2.2.11.2.7 Fisheries

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

2.2.11.2.8 Vegetation and Wetlands

Other mitigation measures under Soils and Water Resources would also apply to Vegetation and Wetlands. The primary mitigation activities concerning Vegetation and Wetlands are as follows:

- 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 outside 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.

2.2.11.2.9 Wildlife

The primary mitigation activities concerning Wildlife are as follows:

- 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 according to BLM authorizations within big game crucial winter range from November 15 to April 30.

- Complete a raptor survey of the PRPA 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 GRRMP 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.

2.2.11.2.10 Special Status Species

The primary mitigation activities concerning Special Status Species are as follows:

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.

- 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.

2.2.11.2.11 Visual Resources

The primary mitigation activities concerning Visual Resources are as follows:

- 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.

2.2.11.2.12 Noise

Mitigation concerning Noise is as follows:

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

2.2.11.2.13 Recreation

Measures under Wildlife, Transportation, Soils, Health and Safety, and Water Resources could apply to Recreation. The primary mitigation activities concerning Recreation are as follows:

- 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.

2.2.11.2.14 Socioeconomics

The primary mitigation activities concerning Socioeconomics are as follows:

- 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.

- Warren 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.

2.2.11.2.15 Cultural Resources

The primary mitigation activities concerning Cultural Resources are as follows:

- Conduct a Class III inventory prior to any ground disturbing activities and identify sites considered eligible for or already on the National Register of Historic Places (NRHP).

- If a site is considered eligible for or is already on the 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 AO would be

immediately notified. Work would not resume until a Notice to Proceed is issued by the BLM AO.

2.2.11.2.16 Health and Safety

Measures listed under Air Quality and Water Quality would also apply to Health and Safety. The primary mitigation activities concerning Health and Safety are as follows:

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

- 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.

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

- 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.

- During construction and upon commencement of production operations, Warren would have a chemical or hazardous substance inventory for all such items that may be at the site. Warren would institute a Hazard Communication Program for its employees and would require subcontractor programs in accordance with the Occupational Safety and Health Administration, 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 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.

- Chemical and hazardous materials would be inventoried and reported in accordance with the Superfund Amendments and Reauthorization Act Title III, 40 CFR 335, if quantities exceeding 10,000 pounds or the threshold planning quantity 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.

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

2.3 NO ACTION ALTERNATIVE

Section 1502.14(d) of the National Environmental Policy Act (NEPA) requires that the alternatives analysis in the environmental assessment (EA) "include the alternative of no action". "No Action" implies that on-going natural gas production activities would be allowed by the BLM to continue in the PRPA, but the proposed field development program (Proposed Action) would be disallowed. 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. Transportation of natural gas products would be allowed from those wells within the PRPA that are currently productive. Additional gas development could occur on private and state lands within the project area under APDs approved by the WOGCC.

Table 2-4 details approximate disturbance acreages on federal, private, and state held surface under the No Action Alternative.

Table 2-4. 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 Gas Wells	0	8	4	12		0	8	4	12
Number of disposal wells	0	1	0	1		0	1	0	1
Gas Well Pads[1]	0	1.6	.8	2.4		0	8.8	4.4	13.2
Disposal Well Pads[2]	0	0.9	0	0.9		0	1.3	0	1.3
Roads[3]	10.4	7.7	3.9	22.0		10.4	9.6	4.8	24.8
Compressors(5)	0	0.5	0	0.5		0	0.5	0	0.5
Gathering Pipelines [4]	0	0	0	0		13.0	9.6	4.8	27.4
Delivery Pipelines[5]	0	0	0	0		6.1	0	0	6.1
Total	**10.4**	**10.7**	**4.7**	**25.8**		**29.5**	**29.8**	**14**	**73.3**

[1]Assumes initial disturbance of approximately 1.1 acres for each well pad and LOP disturbance of 0.2 acre per well pad.
[2]Assumes initial disturbance of approximately 1.2 acres per well pad and LOP disturbance of 0.9 acres per well pad.
[3]Assumes an average of 0.33 mi of new roads with a 30-ft average disturbance width for each well. All disturbance except for the estimated 14-ft wide road travelway and adjacent ditches would be reclaimed for the LOP.
[4]Assumes an average of 0.33 mi of new gas gathering and water discharge lines with a 30-ft average disturbance width for each well. All disturbance will be reclaimed for the LOP.
[5]Assumes an average disturbance width of 50 ft. All disturbance will be reclaimed for the LOP.

The rationale behind these acreages is as follows:

- Since the decision would be to not allow drilling on federal acreage, the 108 wells

proposed for federal surface would not be approved. Therefore, no acreage would be disturbed on federal surface by well sites.

- Only private and State of Wyoming surface would be utilized for well pads, but federal surface would be disturbed for roads and pipelines. Since only 12 wells or 10 percent of the proposed number of wells (120) would be drilled, disturbances due to common support facilities (roads and pipelines) were assumed to be 10 percent of the Proposed Action disturbances on federal surface.
- None of the 10 injection wells proposed for federal surface would be drilled, but 10 percent, or one injection well would be drilled on private surface.

2.4 COMPARISON OF ENVIRONMENTAL IMPACTS OF FIELD DEVELOPMENT ALTERNATIVES

A summary of impacts for the Proposed Action and the No Action Alternative, analyzed in this EA is provided in Table 2-5. A detailed analysis of project impacts and mitigation measures is presented in Chapter 4.

Table 2-5. Comparative Impact Summary.

RESOURCE ELEMENT	PROPOSED ACTION	NO ACTION ALTERNATIVE
General		
Proposed Disturbance (acres)		
Ancillary Facilities	4.5	0.5
Well Sites	144.4	14.5
Pipelines	204.6	33.5
New & Upgraded Roads	144	24.8
Disturbance - Project Area (acres)		
before reclamation	497.5	73.3
after reclamation	153.0	25.8
Range Resources	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES
AUM's Lost Following Reclamation	14.6	2.5
Air Quality	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP's and FLPMA	Yes	Yes
Compliance with State and National Ambient Air Quality Standards	Yes	Yes
Hazardous Air Pollutant Concentrations	NSI	NSI
Direct Visibility Impacts to Sensitive Areas (0.5 delta-deciview threshold)	NSI	UAD
Transportation	**NSI**	**NSI**
Compliance with RMP	YES	YES

RESOURCE ELEMENT	PROPOSED ACTION	NO ACTION ALTERNATIVE
Traffic Volume (ADT relative to 2002 data) WYO 430	Increase of ADT: 30%	Lower than Proposed Action
Minerals/Paleontology	**NSI w mitigation**	**NSI w/mitigation**
Compliance with RMP's	YES	YES
Disturbance to Fossil Resources	UNKI	UNKI
Soils	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP's	YES	YES
Total Surface Disturbance within the Project Area within the CIA Area	1.0 percent 1.6 percent	0.15 percent UAD
Erosion w/ Effective Erosion Control	NSI w/mitigation	UAD
Additional Erosion: Year 5 (tons/year) w/ Effective Erosion Control	NSI w/mitigation	UAD
Compliance with EO 11987 (reclamation)	YES	YES
Water Resources	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP's	YES	YES
Compliance with CWA and State Water Quality Standards	YES	YES
Groundwater Quality Degradation Potential	Improbable	Improbable
Fisheries	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES
Vegetation & Wetlands	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP	YES	YES
Compliance with Section 404 of the CWA, EO' 11990 (wetlands), 11988 (floodplains)	YES	YES
Special Status Plants	**NSI w/ mitigation**	**NSI w/ mitigation**
Wildlife	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP's, FWS, and WGFD objectives and stipulations	YES	YES
Big Game Crucial Winter Range	**NSI w/ mitigation**	**NSI w/ mitigation**
Greater Sage Grouse Leks, Nesting & Severe Winter Relief Habitats	**NSI w/ mitigation**	**NSI w/ mitigation**
Raptor Nesting Habitat	**NSI w/ mitigation**	**NSI w/ mitigation**

RESOURCE ELEMENT	PROPOSED ACTION	NO ACTION ALTERNATIVE
Special Status Wildlife & Fish		
Compliance with RMP's and FWS: Animals and Fish	YES	YES
Potential Disturbance to FWS Listed & Proposed Wildlife Species		
Black-Footed Ferret	NSI w/ mitigation	NSI w/ mitigation
Yellow Billed Cuckoo	NWI w/ mitigation	NSI w/ mitigation
Bald Eagle	NSI w/ mitigation	NSI w/ mitigation
Potential Disturbance to Special Status Fish	NSI w/ mitigation	NSI w/ mitigation
Visual Resources	**Moderate, Short Term**	**Low**
Compliance with RMP's	YES	YES
Compliance with BLM VRM Class	NSI in Class IV VRM areas	NSI in Class IV VRM areas
Noise	**NSI**	**NSI**
Compliance with RMP	No standards specified	No standards specified
Construction and Traffic Noise	Minimal and Short Term	Lower than Proposed Action
Recreation/Wilderness	NSI w/ mitigation	NSI w/ mitigation
Compliance with RMP's	YES	YES
Quality of Recreation / Wilderness Experience	NSI w/ mitigation	NSI w/ mitigation
Displacement of Recreation/Wilderness Values	NSI w/ mitigation	NSI w/ mitigation
Socioeconomics	**NSI, Positive**	**NSI**
Compliance with RMP	No standards specified	No standards specified
Employment Rate	Increase	Lower than Proposed Action
Tax & Royalty Revenue over 40 years (Ad valorem, federal mineral royalty, WY severance tax, and sales & use tax)	$116,000,000	$6,570,000
Cultural Resources	**NSI w/ mitigation**	**NSI w/ mitigation**
Compliance with RMP's	YES	YES
Compliance with the NRHP[2] guidelines	YES	YES
Sites Eligible for the NRHP in the WRPA	30	Same as Proposed Action
Impacts to Known or Anticipated Cultural Resources	NSI if avoided	Lower than Proposed Action
Health & Safety	**NSI**	**NSI**
Compliance with RMP's	YES	YES
Risk to the Public	Slight Increase	Lower than Proposed Action

Abbreviations:

ADT - Average daily traffic
AUM - Animal Unit Month
CIA - Cumulative Impacts Analysis
CWA - Clean Water Act
EO - Executive Order
ESA - Endangered Species Act
FWS - Fish and Wildlife Service
NSI - No significant impacts
RMP - Resource Management Plan
SI - Significant impacts
UAD - Unquantified additional development
UNKI - Unknown impact until site-specific location is proposed and surveys are completed
VRM - Visual Resource Management
WGFD - Wyoming Game and Fish Department
w/ - with
w/o - without

CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental assessment (EA) for the proposed Warren Shallow Gas Development project discusses environmental, social, and economic factors as they currently exist within the Pacific Rim Shallow Gas project area (PRPA). 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], Pacific Rim 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, Pacific Rim 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 PRPA lies on the southeastern flank of the Rock Springs Uplift, a major Laramide structural element that 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 uplift during the Early Tertiary (Figure 3-1). 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 in turn overlain by marine shales of the Lewis Formation, beach and nearshore sandstones of the Fox Hills Formation, coal-bearing rocks of the Lance (Latest Cretaceous) and Fort Union (Paleocene) Formations, the fluvial rocks of the Wasatch Formation (Eocene), and lacustrine rocks of the Green River Formation (Eocene) that form the flanks of the uplift.

Structural dips in the PRPA are gentle, measuring between 5 and 9 degrees off the flanks of the uplift. A major northwest-southeast trending reverse fault system, the Sparks Ranch Thrust, extends several miles along the Colorado-Wyoming border south of the PRPA. This fault which was active during the Laramide Orogeny, in latest Cretaceous time, has an estimated displacement of about 3 to 5 miles to the northeast.

Movement on the Sparks Thrust and resulting crustal shorting caused minor folds and faults to develop between it and the southern end of the Rock Spring Uplift during the early Tertiary (Roehler 1979b). Three of these minor cross-trending folds occur in and adjacent the PRPA. From north to south, these include the Pine Butte Syncline, Salt Wells Anticline, and Red Creek Syncline (Figure 3-1). The axis of the Pine Butte Syncline, just north of the PRPA, trends northeastward from the SE/4 of Section 13, T15N, R102W through the NW/4 of Section 17, T 15N, R101W, before

changing to a southeasterly trend toward Kinney Rim. The axis of the Salt Wells Anticline trends southeastward through the center of Section 11, T14N, R102W into the center of Section 16, T14N, R101W. Further westward the Salt Wells Anticline is bound by reverse faults on both its northern and southern flanks. The fault on its northern flank dies out southeastward before reaching the PRPA, so that in the PRPA the anticline is only fault bound along its southern flank. This unnamed bounding fault dips northeastward steeply, at about 65 degrees. The fault lies buried beneath and does not break Quaternary alluvium in East Salt Wells Creek in the SW/4 of Section 18, T14N, R101W and East Draw in SE/4 Section 21, T14N, R101W. The axis of the Red Creek Syncline trends northeastward just south of the PRPA from the north flank of Scrivner Butte into the northern half of Section 13, T 13N, R101W. Rocks in the southern flank of this syncline, which bounds the Canyon Creek Oil Field on its northern side, strike to the northeast and dip very gently (about 2 degrees) to the northwest.

Geologic mapping by the USGS and Wyoming Geologic Survey (Love and Christiansen 1985, Love et al. 1993, and Roehler 1973, 1974, 1978, 1987) documents sedimentary deposits of Quaternary and Early Tertiary age crop out in the PRPA (Figure 3-1). These rocks are overlain at the surface by unconsolidated Quaternary alluvium along the northward drainages of East Salt Wells Creek and its tributary East Draw and Scheggs Draw, and southward drainage of Vermillion Creek and Granary Draw.

Early Tertiary deposits in the PRPA 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, 1979a, b, 1985, 1987, 1991 a-b, 1992 a-c, 1993; Winterfeld 1982). These deposits comprise three geologic units, from youngest to oldest, the Green River, Wasatch, and Fort Union Formations (Figure 3-2).

On the east flank of the Rock Springs Uplift, a major angular unconformity separates the Fort Union Formation from underlying Cretaceous rocks. To the north of the PRPA the Fort Union Formation rests on the Lance Formation. Progressively southward the Fort Union Formation truncates increasingly older Cretaceous rocks so that within the PRPA, it rests unconformably on the Lewis Shale. Further southward the Fort Union Formation truncates the Lewis Shale and rests on the Almond Formation. Coincident with the unconformable contact in some places is a very well developed, deeply weathered, paleosol horizon (Ritzma 1957).

Green River Formation

Rocks of the Green River Formation (Early Eocene) exposed within the PRPA include four members. From oldest to youngest these include the Laney, Wilkins Peak, Tipton, and Luman, all of which accumulated in the ancient Green River Lakes system. All four members crop out along the southern and eastern edges of the area. None of the members contain economic mineral deposits in the PRPA, but do contain uneconomic deposits of oil shale, and produce vertebrate fossils of scientific interest and significance.

Only the basal rocks of the Laney Member occur in the PRPA, represented by the lower 20 feet of the LaClede Bed, which only occur along the eastern margin of Section 8, T15N, R100W along the west side of Kinney Rim about ½ mile south of Pine Butte. The basal rock of the Laclede Bed consists chiefly of oil shale with lesser amount of limestone, sandstone, claystone and tuff that overlie the Cathedral Bluffs Member of the Wasatch Formation.

The Wilkins Peak Member includes a maximum of 522 feet of gray-green, and gray-brown silty to

sandy mudstone and thin interbeds of gray very fine grained calcareous and micaceous sandstone, brown flaky oil shale, gray tuff, gray and brown mudstone, gray dolomite, and tan algal limestone that accumulated in ancient Lake Gosiute (Roehler 1974, 1977a-c, 1991 a-b; 1992 a-c, 1993). The Wilkins Peak Member form gently rolling hills that form the south facing back slope of Rifes Rim and occupy the central axis of the Red Creek Syncline.

The Tipton Shale consists of a maximum of about 157 feet of brown flaky oil shale and very thin interbedded brown ostracodal limestone and brown tuffaceous siltstone that underlies the Wilkins Peak Member of the Green River Formation and overlies the Niland Tongue of the Wasatch Formation. Beds of the Tipton also form the back slope of Rifes Rim.

The Luman Tongue consists of a maximum of about 483 feet of organic-rich carbonaceous shale, limestone, sandstone, and mudstone that underlie the Niland Tongue and overlie the main body of Wasatch Formation. The Luman Tongue forms the top of Rifes Rim.

Wasatch Formation

Rocks of the Wasatch Formation (Early Eocene) exposed in the PRPA include three members. From youngest to oldest these include the Cathedral Bluffs, Niland Tongue, and Main Body members. None of the members of the Wasatch contain economic mineral accumulations within the PRPA, but all produce vertebrate fossils of scientific interest and significance. The Niland contains economic deposits of coal immediately south of the PRPA in the Vermillion Creek Basin.

The Cathedral Bluffs Member consists of terrestrial and fluvial sediments that accumulated in chiefly upland environments surrounding Lake Gosiute. Deposits consist of a maximum of about 1,200 feet of gray, green and variegated mudstone; interbedded gray, fine to coarse-grained, partly crossbedded sandstone and minor thin beds of gray-brown shale, algal limestone, oolitic limestone, and gray calcareous siltstone. The member interfingers with and is replaced laterally toward the basin center by sediments of the Wilkins Peak Member of the Green River Formation that accumulated chiefly in lake environments. Within the PRPA this unit occurs along the eastern flank of Pine Butte and head of Alkali Creek in Sections 8, 17, 18, 19, 29 and 30, T 15N, R100W.

The Niland Tongue consists of terrestrial and fluvial sediment that lies stratigraphically between the overlying Tipton and underlying Luman tongues of the Green River Formation and forms low-lying exposures above the rimrock of Rifes Rim. Deposits of the Niland Tongue include a maximum of about 315 feet 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 crops out over the central parts of the PRPA where it forms a series west-east trending, high standing ridges and intervening valleys below Rifes Rim. The member includes a maximum of 1,730 feet 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. The Main Body overlies the Fort Union Formation unconformably, the line of contact between the two formations crosses WYO 430 at Scheggs Draw and then trends southward and westward crossing the highway again at East Draw.

Fort Union Formation

The Fort Union Formation (Paleocene) crops along in the western parts of the PRPA along the east side of WYO 430. The formation is a maximum of about 1,715 feet thick and 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 Formation, the Fort Union Formation weathers to a series of high standing ridges and intervening valleys. Pollen (Kirschbaum and others 1988, 1994, Nicols 1999) and vertebrate fossils (Winterfeld 1982, Wilf and others 1998) indicate that earliest Paleocene strata are probably missing from the section along the eastern flank of the Rock Springs Uplift because of either an intraformational unconformity or the unconformity at the base of the formation. The Fort Union Formation contains uneconomic coal deposits in the PRPA and produces vertebrate fossils of scientific significance. Economic deposits of coal occur a few miles north of the RPA in the Burley Draw, Sand Butte Rim, and Black Butte areas.

Older Sedimentary deposits

The Fort Union Formation is underlain by Phanerozoic sedimentary rocks, that with the exception of lacking Silurian and Ordovician deposits, range in age from Cretaceous to Cambrian in age (Table 3-1). 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 PRPA, (http://wogra.wygisc.uwyo.edu/wyoims2/wims2awogra.html).

3.1.1.2.2 Leasable Minerals

Petroleum resources, both oil and gas may occur in Cretaceous rocks underlying the PRPA and the immediate vicinity. The nearest producing oil and gas field is the Salt Wells Field in T14N, R103W. This field discovered in 1949 has produced 317,614 BBLS of oil and 24,597,389 MCF gas, as of November 3, 2003 from the Dakota, Lakota, Frontier, Mesaverde, and Morrison Formations. The field is developed in a faulted anticline, the Salt Wells Anticline, which as described above, trends southeastward across the PRPA. Although it has been extensively drilled in the PRPA, no production has been established in area itself.

Coal occurs in Tertiary Fort Union Formation in the Burley Draw 7.5 minute quadrangle (Roehler 1974) and in the Wasatch Formation in the Ericson – Kent Ranch and Chicken Creek Southwest 7.5 minute Quadrangles (Roehler 1973, 1978). The coals are sparse, thin and discontinuous. The coals in the Wasatch Formation have low Known Mineral Deposit Area (KMDA) value and the PRPA is considered an area less favorable for mineral development, (http://wogra.wygisc.uwyo.edu/wyoims2/wims2awogra.html).

Coalbed Methane

Cretaceous and Tertiary coal beds buried in the subsurface around the Rock Springs Uplift are considered to be exploration targets for coalbed methane to a depth of about 5,000 feet (McCord, 1980). Coal rank around the Rock Springs Uplift at exploitable depth ranges from subbituminous to high volatile C bituminous (Hamilton et al 1994).

The Rifes Rim and Pacific Isle exploratory CBM units partially overlap the boundaries of the PRPA.

Primary coalbed methane targets in these units and within the PRPA are in the Almond Formation (Williams Fork Formation) of the upper Mesaverde Group. Roehler (1979b) who mapped the Almond Formation in the Ericson Kent Ranch, just northwest of the PRPA, subdivided the formation into three informal units. The thickest coals occur in the middle part of the formation, about 400 feet below the top of the formation. Depth to the top of the Almond Formation (top of the Mesaverde Group) ranges from about 1,200 feet to 2,000 feet in the western and eastern parts of the PRPA, respectively. Gas content of coals in the upper Mesaverde Group range from less than 1 to more than 540 scf/ton, but is generally less than 200 scf/ton (Scott 1994). Net coal maps of the upper part of the Mesaverde Group beneath the PRPA indicate 20 to 40 feet of coal present (Tyler and Hamilton 1994, Scott and others 1995). Secondary CBM methane targets occur in the lower part of the Mesaverde Group (Ericson Sandstone and Iles Formation). Gas contents of coals from the lower Mesaverde range from 0 to more than 650 scf/ton (Scott 1994).

Tertiary age coals of the Fort Union and Wasatch Formations are probably too thin and discontinuous to be considered economic targets for coalbed methane development in the PRPA. The Lance Formation, which contains economic coal deposits to the north, is either absent or preserved as a wedge edge in the subsurface of the area, having been eroded away prior to deposition of the Fort Union Formation of Paleocene age. That erosion episode is represented by the unconformity at the base of the Fort Union Formation.

Oil shale occurs in the Green River Formation south of Rifes Rim and has a moderate favorability ranking.

3.1.1.3 Geologic Hazards

Naturally occurring geologic hazards include fault generated earthquakes, floods, landslides or other mass movements. In addition, pyrophorocity (spontaneous combustion), subsidence, and subsidence generated earthquakes have been noted as potential hazards of CBM development.

There are no known earthquake epicenters mapped within the PRPA (NEIC 2003, WGS 2003). Thirty magnitude 2.0 and greater earthquakes have been recorded in Sweetwater County, exclusive of the trona mine region west of Green River. Of these earthquakes, those closest to the PRPA area include: (1) a magnitude 3.9 event that occurred on January 5, 1964, approximately 23 miles south of Rock Springs (2) a magnitude 2.5 earthquake that occurred on April 29, 1986 northeast of Pine Mountain in south-central Sweetwater County; and (3) two magnitude 3.2 earthquakes that occurred on March 1, 1984 and September 14, 1984, approximately 14 miles southeast of Point of Rocks and approximately 13 miles east-southeast of Point of Rocks (Stover, 1988; U.S. Geological Survey, 1994), respectively.

The PRPA falls within seismic Zone 1 of the Uniform Building Code (UBC) Seismic Zone Map (1997). UBC seismic zones are in part defined by the probability of having a certain level of ground shaking (horizontal acceleration) in 50 years. Zone 1 Effective Peak Acceleration, % of gravity is 5 to 10% (Seismology Committee of the Structural Engineers Association of California - Building Standards, September-October, 1986). There is a 90% probability that the 5 – 10 % values will not be exceeded in 50 years and a 100% probability that the values will be exceeded in 475 to 500 years. Case, Toner, and Kirkwood (2002) noted that an average peak acceleration of 10.0%g could be applied to the design of a non-critical facilities located in that part of Sweetwater County, including the PRPA, that falls into Seismic Zone 1.

There is one fault with surface expression in the PRPA area (Roehler 1973). This unnamed east-southeast trending reverse fault bounds the southern flank of the Salt Well Anticline and crosses

WYO 430 into the PRPA in the SW/4 of Section 18, T14N, R101W. From here the fault trends southeastward into the SE/4 of Section 21, T14N, R101W. The fault dips steeply northeastward (about 70 degrees) and places the Fort Union Formation in fault contact with the overlying Wasatch Formation at the surface, representing a maximum displacement of less than 500 feet. As described above, the fault is mapped as lying buried beneath Quaternary alluvium in the valley of East Salt Creek and East Draw, suggesting that it has not had recent movement.

The nearest active fault system to the PRPA is the Chicken Springs Fault System in northeastern Sweetwater County about 75 miles to the northeast. The Chicken Springs fault system is composed of a series of east-west trending segments in the northeastern corner of Sweetwater County. The most recent activation on the system appears to be Holocene in age.

Reconnaissance-level studies indicated that the fault system is capable of generating a magnitude 6.5 earthquake. A magnitude 6.5 earthquake on the Chicken Springs fault system would generate peak horizontal accelerations of approximately 4%g at Wamsutter and approximately 4.8%g at Rawlins and somewhat less at the PRPA. These accelerations would be roughly equivalent to an intensity V earthquake, which may cause some light damage.

The U.S. Geological Survey (USGS) publishes probabilistic acceleration maps for 500-, 1000-, and 2,500-year time frames. The maps show what accelerations may be met or exceeded in those time frames by expressing the probability that the accelerations will be met or exceeded in a shorter time frame. For example, a 10% probability that acceleration may be met or exceeded in 50 years is roughly equivalent to a 100% probability of being exceeded in 500 years. Based upon the 500-year map (10% probability of exceedance in 50 years) the estimated peak horizontal acceleration in the PRPA ranges from approximately 5%g in the southeastern corner to 6%g in the northwestern corner. These accelerations are roughly comparable to intensity V earthquakes (3.9%g – 9.2%g). These accelerations are comparable to the accelerations to be expected in Seismic Zone 1 of the Uniform Building Code. Intensity V earthquakes can result in cracked plaster and broken dishes. Based upon the 1000-year map (5% probability of exceedance in 50 years), the estimated peak horizontal acceleration in the PRPA ranges from 8%g in the far southeastern corner to over 9%g in the northeastern corner. These accelerations are roughly comparable to intensity V earthquakes (3.9%g – 9.2%g). Intensity V earthquakes can result in cracked plaster and broken dishes (Case, Toner, and Kirkwood 2002).

There are no mass movement deposits mapped in the area and none were observed during field reconnaissance. Topographic relief is approximately 991 feet, from 6,840 feet in East Salt Wells Creek to 7,950 feet along the western side of Kinney Rim. Slope in the northern part of the area is low to moderate and varies from low to moderate over the central part of the area. Slopes are steepest along the north side of Rifes Rim (Sec. 32, T17N, R100W) where over a lateral distance of about 1000 feet elevation rises on average 230 feet, and along the west side of Kinney Rim where over a lateral distance of about 1,600 feet elevation rises at most 360 feet, yielding slopes of about 13 degrees.

Rifes Rim itself is a vertical cliff formed in limestones of the Luman Tongue of the Green River Formation, that dips to the south opposite to the slope which dips to the northwest, thus lessening the chance for naturally occurring mass movements. Kinney Rim is a prominent west facing escarpment that bounds the area to the east is developed in the Laney Formation. Numerous springs occur along the base of the escarpment and mass movement deposits are developed along its length (http://www.wygisc.uwyo.edu/24k/surfgeol/quad3.html, http://www.wrds.uwyo.edu/wrds/wsgs/hazards/landslides/lshome.html). Additional steep slopes and vertical to near vertical

cliffs are developed in massive fluvial sandstone in the Fort Union and Wasatch Formations in the central part of the PRPA, but dips are low making mass movement less likely.

Pyrophoricity (spontaneous combustion) has been cited as potential hazards of coal gas development. Spontaneous combustion of coal has long been a concern for mankind and shallow coal mine fires in areas of abandoned mines are today still an environmental concern throughout the world (Lyman and Volkmer 2001).

Spontaneous combustion of coal is unlikely to occur in naturally exposed outcrops of coal because by the time coal is exposed by erosion it is already too degassed to ignite spontaneously (Coates and Heffern, 1999). Studies of in-situ coal gasification (UCG) conducted during the 1970's in Wyoming suggest that even under extreme efforts to maintain combustion (by injecting air into the burn zones) of underground coals ignited in bore holes, coal burning away from the ignition area cannot be sustained. Loss of permeability associated with plugging of fissures by tar and combustion products resulted in the fires burning themselves out. In their study of Powder River Basin CBM wells, (Lyman and Volkmer 1999) found that spontaneous combustion of coal beds during coalbed methane production is unlikely because completion methods, although “open-hole”, configure the well to keep air, necessary for combustion, out of the system. ”Even where the coal has been completely dewatered, insufficient oxygen is present for oxidation to be carried forward.” After coal gas extraction is complete, a CBM well leave no underground voids susceptible to subsidence and associated coal ignition as seen in abandoned underground mines, which are susceptible to spontaneous ignition.

Ground subsidence (resulting from withdrawal of coalbed-methane related water) has also been cited as a potential hazard of CBM development. A number of documented cases demonstrate the association of withdrawal of underground fluids and subsidence. The best examples include the San Joaquin Valley in California, Las Vegas, New Orleans, Houston, and Mexico City. Subsidence in these areas all are chiefly related to removal of water for human consumption or agricultural use. Removal of water from underlying saturated, chiefly unconsolidated and porous sand and gravel aquifers, lowers the water table, and causes the previously saturated zones to compress, causing subsidence. Saturated unconsolidated sands and gravels and porous clays can compress significantly. In some cases as much as 29 feet of subsidence has resulted. The subsurface geologic conditions in the PRPA, however, differ significantly from these areas. The bedrock underlying the area is compacted and consolidated and porosity is much lower. In comparison unconsolidated sands and gravels and clays have porosity values of as high as 50% and 88% respectively (Poland 1984), whereas values for consolidated clay (shale) and sand (sandstone) in the PRPA have porosity values at most as high as 10% and 30%, respectively (Freeze and Cherry 1979). Calculations of modeled ground subsidence associated with coalbed methane production for the Wyodak coal in the Powder River Basin, near Gillette indicate that subsidence of less than 2 inch can be expected (Case, Edgar, and DeBruin 2002). This amount of subsidence is not considered significant and is very unlikely to initiate earthquakes.

3.1.2 Paleontology

3.1.2.1 Overview

Paleontologic resources within sedimentary deposits exposed at the surface of the PRPA 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 area. 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 fossils of scientific interest and significance. Scientifically significant fossil vertebrates have been recovered from within the area or immediately adjacent areas in the Wasatch (Morris 1954, Roehler 1972, 1991 a-b, 1992 a-c, 1993, Roehler et al. 1988, Casilliano 2003, Holroyd 2003) and Fort Union (Winterfeld 1982) Formations. Scientifically significant fossil vertebrates, primarily fish, but other groups as well, have been recovered from the Green River Formation throughout its extent.

Green River Formation

Plant, invertebrate, and vertebrate fossils are known from the Green River Formation. The LaClede Bed of the Laney Member yields fossils of gastropods, bivalves, and fish. 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 *Goniabasis 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 from that member. The fossil mammal locality discovered in an ostracodal limestone, produced the mold of a jaw of the early horse *Hyracotherium*, with incisors preserved and impression of molars.

Fossils of fresh water molluscs are abundant throughout the Luman Tongue and the assemblages of fossils are commonly characterized by the large prosobranch gastropods *Goniabasis 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 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 (Morris, 1954; Gazin, 1962; Honey, 1992; Roehler, 1991 a-b; 1992 a-c, 1993). The fossil mammals include primates, insectivores, marsupials, condylarths (archaic hoofed animals), artiodactyls, perissodactyls, carnivores, creodonts, bats, rodents, arctocyonids, and tillodonts. The Cathedral Bluffs Member also contains fossil vertebrates but apparently is not as rich as the other members of the Wasatch Formation (Honey 1988, Morris, 1954).

Review of institutional records (University of California, University of Colorado, University of Wyoming) reveals that more than 250 fossil vertebrate localities have been identified in the Wasatch Formation along the east flank of the Rock Springs 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 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 these sediments (Holroyd 2003).

These 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 (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, 1992a-c; and field notes on file at UCMP).

Not much work has been conducted by paleontologists on the Wasatch Formation to date in the PRPA itself, however. During field reconnaissance, vertebrate fossils including turtle bones and shell fragments, crocodile osteoderms, gar fish scales, and mammalian teeth and postcranials were found at a single locality in the N/2 Section 10, T14N, R101W. This locality suggests that additional undiscovered fossil localities are present in the PRPA.

Fort Union Formation

The high potential of the Fort Union Formation to produce scientifically significant fossils of vertebrates, invertebrates and plants in outcrops exposed along the eastern flank of the Rock Springs Uplift is well documented (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 of representing multituberculates, marsupials, proteutherian, 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).

These localities and specimens from them are of high scientific significance and interest for several reasons including: (1) they yield small mammals (Winterfeld 1982), reptiles and amphibians many of which are new species and are the subject of ongoing study by researchers at Idaho State University and the Carnegie University; (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.

Not much work has been conducted by paleontologists on the Fort Union Formation to date in the PRPA itself, however. During field reconnaissance, vertebrate fossils including turtle bones and shell fragments, crocodile osteoderms and mammalian teeth and postcranials were found at a three localities in the N/2 Section 19, T14N, R101W. These localities suggest that additional undiscovered fossil localities are present in the PRPA.

Paleontology Ranking

The Wyoming BLM considers the Wasatch and Green River Formations to be Class 5 paleontological formations which means 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 paleontological formation which means that it is a fossiliferous sedimentary geologic unit where fossil content varies in significance, abundance, and

predictable occurrence.

Class 5 paleontological formations require mitigation of ground disturbing activities. Class 3 paleontological 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 Introduction

Air quality within any region may be influenced by a combination of factors including climate and meteorology, the magnitude and spatial distribution of local and regional emission sources, and the chemical properties of emitted pollutants. Within the lower atmosphere, synoptic and local scale air masses interact with regional topography to influence atmospheric dispersion and transport of pollutants. The following sections summarize the climatic and air quality conditions prevailing within the Pacific Rim Shallow Gas Project Area (PRPA) and surrounding region.

3.2.2 Climate

The PRPA is located in a semiarid mid-continental climate regime typified by dry windy conditions, limited rainfall, and long cold winters. The ground elevation across the project area ranges from 6,900 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 25 miles northeast of the project area at an elevation of 6,720 feet (Western Regional Climate Center, 2003).
The annual mean precipitation recorded at Bitter Creek is 6.3 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 0.27 inches, and May is the wettest month with an annual mean of 1.09 inches. The annual average snowfall is 18 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 9°F to 34°F, while summer temperatures range from 44°F to 81°F. Recorded extreme temperatures are -46°F in January 1971 and 103°F in July1969. Table 3-3 summarizes the climatic conditions by month.

Wind speed and direction along with vertical temperature profiles in the lower atmosphere greatly affect the transport and dispersion of air pollutants. Within the region, the potential for atmospheric dispersion is relatively high due to the frequency of strong winds. However, calm periods and nighttime cooling often enhance air stability, thereby inhibiting air pollutant transport and dilution. During periods of stable atmospheric conditions, cold air tends to be trapped at the surface and vertical mixing of pollutants is limited. Temperature inversions are of shorter duration during the summer months when daytime ground-level heating rapidly leads to inversion break-up and increased vertical mixing.

The nearest comprehensive wind measurements are recorded at the Rock Springs, Wyoming airport, approximately 35 miles northwest of the project area. Winds blow predominately east

through northeast 46 percent of the time and the average wind speed is nearly 12 miles per hour (5.33 meters/second). Figure 3-1 presents a wind rose for the Rock Springs Airport for the period 1991 through 1995. The wind rose depicts the direction of wind flow and thus illustrates the predominate directions in which emitted air pollutants would be transported. The wind data are tabulated in Tables 3-4 and 3-5.

The degree of stability in the atmosphere is important to the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited and the dispersion of pollutants is inhibited. Temperature inversions can result in very stable conditions with virtually no vertical air motion thereby restricting dispersion. Conversely, in unstable conditions upward and downward movement in the atmosphere is prevalent and the dispersion of pollutants is enhanced.

Atmospheric stability is typically categorized by stability classes “A” through “F”, with “A” representing a high degree of atmospheric turbulence, and “F” representing a high degree of atmospheric stability. As illustrated in Table 3-6, atmospheric stability in the region favors mid-range conditions associated with fair dispersion capacity 46.6% of the time.

Table 3-3. Average Monthly Climatic Conditions Recorded at Bitter Creek, Wyoming (1962-2003)

Month	Average Temperature Range (Fahrenheit)	Average Monthly Temperature (Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
January	7.7 – 32.2	19.9	0.32	3.6
February	11.0 – 35.7	23.4	0.28	3.4
March	18.6 – 44.0	31.3	0.27	1.9
April	25.1 – 54.5	39.9	0.47	1.9
May	32.9 – 65.7	49.3	1.09	0.0
June	40.4 – 76.0	58.2	0.81	0.0
July	46.7 – 84.1	65.3	0.59	0.0
August	45.0 – 82.3	63.7	0.55	0.0
September	35.9 – 72.5	54.2	0.68	0.0
October	26.2 – 59.6	42.9	0.63	0.9
November	16.7 – 42.8	29.5	0.37	2.9

December	8.5 – 33.3	20.9	0.25	3.4
Annual Average	26.2 – 56.9	41.5	6.30	18.0

Source: Western Regional Climate Center (2003). Data collected at Bitter Creek, Wyoming from 1962 through April 2003.

Table 3-4. Wind Direction Frequency Distribution[1]

Direction of Wind Origin	Frequency	Direction of Wind Origin	Frequency
North	1.3%	South	6.7%
North Northeast	1.5%	South Southwest	5.8%
Northeast	4.5%	Southwest	11.6%
East Northeast	4.1%	West Southwest	19.8%
East	2.7%	West	14.7%
East Southeast	1.3%	West Northwest	3.3%
Southeast	2.5%	Northwest	1.8%
South Southeast	3.6%	North Northwest	1.3%

Table 3-5. Wind Speed Frequency Distribution[1]

Wind Speed Category (miles per hour)	Frequency
Calm to 4.0	4.1%
4.0 to 7.5	22.7%
7.5 to 12.1	24.8%
12.1 to 19.0	21.7%
19.0 to 24.7	8.9%
Greater than 24.7	4.3%

[1] Source: Wyoming DEQ-AQD (2002). Meteorological data collected at Rock Springs Airport for years 1991, 1992, 1993, 1994, and 1995.

3.2.3 Air Quality

3.2.3.1 Regulatory Environment

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. The Clean Air Act (CAA) established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. Standards have been set for six pollutants, termed criteria pollutants, which include sulfur

dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter less than 10 microns in diameter (PM_{10}) or less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb).

Figure 3-1. Rock Springs, Wyoming Wind Rose

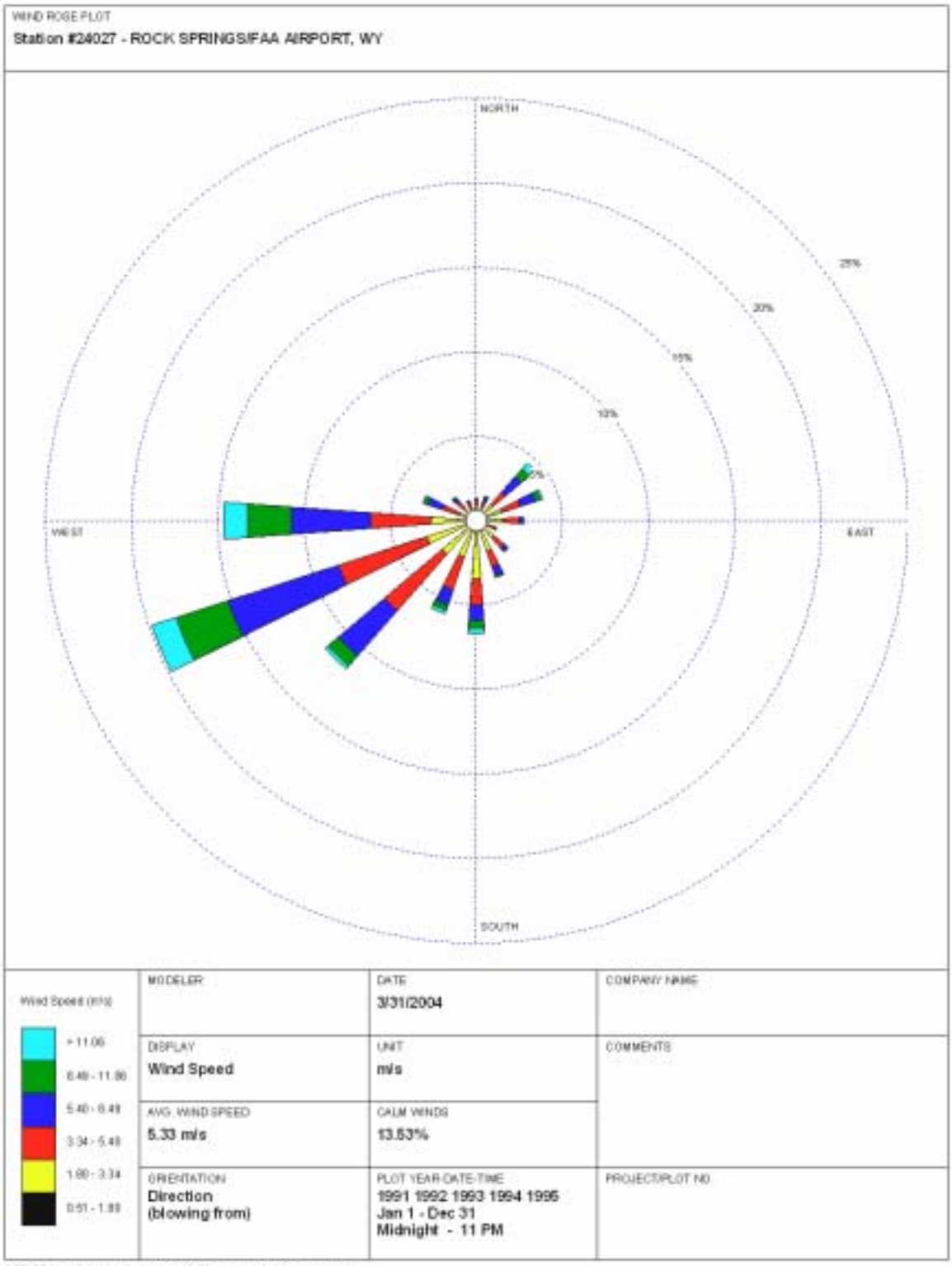


Table 3-6. Atmospheric Stability Class Distribution

Stability Class	Percent Occurrence
A	0.5%
B	4.4%
C	9.7%
D	46.6%
E	14.7%
F	10.5%
Calm	13.5%

Source: Wyoming DEQ-AQD (2002). Wind data collected at Rock Springs Airport for years 1991, 1992, 1993, 1994, and 1995.

Under the Prevention of Significant Deterioration (PSD) provisions, incremental increases in criteria pollutant concentrations are limited above a legally defined baseline level. All national parks and many 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.

Toxic air pollutants, also known as hazardous air pollutants (HAPs), are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental impacts. The EPA has classified 189 air pollutants as HAPs. Examples of listed HAPs emitted by oil and gas operations include formaldehyde (HCHO), BTEX compounds (benzene, toluene, ethylbenzene, isomers of xylene) and normal-hexane (*n*-hexane).

The CAA requires EPA to regulate emissions of toxic air pollutants from a published list of industrial sources referred to as "source categories." As required under the Act, EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants. Under section 112(d) of the CAA, the EPA is required to develop regulations establishing national emission standards for hazardous air pollutants (NESHAP) for all industries that emit one or more of the pollutants in major source quantities. These standards are established to reflect the maximum degree of reduction in HAP emissions through application of maximum achievable control technology (MACT). Source categories for which NESHAPs have been implemented include Oil and Natural Gas Production and Natural Gas Transmission and Storage.

This NEPA analysis compares potential air quality impacts from the Proposed Action and Alternatives to applicable ambient air quality standards and PSD increments. However, 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. Although 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.

3.2.3.2 Pollutant Characteristics

Criteria Air Pollutants

The term NO_X is used to describe the combination of nitrogen monoxide (NO), NO_2, and other nitrogen oxides including dinitrogen oxide (N_2O). The National Ambient Air Quality Standard refers only to NO_2, rather than all species of NO_X. Nitrogen oxides are by-products from the combustion of fossil fuels. The primary sources of anthropogenic NO_X include automobiles and power plants. Furnaces and gas stoves also contribute to NO_X emissions. Most NO_X emissions are emitted in the form of NO, which is not stable in the atmosphere and is eventually converted to NO_2. Nitrogen dioxide is a toxic, reddish-brown gas that is reactive in the atmosphere and plays a role in the formation of smog. Long-term human exposure to NO_2 may lead to increased susceptibility to respiratory infection and may cause alterations in the lung. Nitrogen oxides also contribute to the formation of acid rain and to visibility impairment.

Carbon monoxide (CO) is formed when fossil fuels are not burned completely. Nation-wide, the primary source of CO is automobile emissions. Other sources of CO include industrial processes, non-transportation fuel combustion and forest fires. Carbon monoxide is a colorless, odorless gas that is poisonous in high concentrations. When humans are exposed to CO, the gas enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. Reduced work capacity, reduced manual dexterity, poor learning capacity and difficulty in performing complex tasks are associated with exposure to elevated levels of CO.

Sulfur dioxide (SO_2) belongs to the family of sulfur oxide gases (SO_x). These gases are highly soluble in water. Sulfur is prevalent in many raw materials, including crude oil, coal, and ore that contains common metals like aluminum, copper, zinc, lead, and iron. SO_x gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil or metals are extracted from ore. SO_2 dissolves in water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and the environment. Health effects of SO_2 exposure range from short-term breathing difficultly to longer-term respiratory illness. SO_2 also contributes to atmospheric deposition ("acid rain") and to visibility impairment.

Ground-level ozone is a gas created through a chemical reaction between NO_X and VOCs in the presence of heat and sunlight. Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOC that help to form ozone. Emissions of NO_x and VOC in hot weather may cause ground-level ozone to form in harmful concentrations in the air. As a result, it is generally known as a summertime air pollutant. Ozone can be transported great distances and therefore contributes to air pollution issues on a regional scale. Primary health effects resulting from exposure to high concentrations of O_3 range from breathing difficulty to permanent lung damage. Ground-level ozone also contributes to plant and ecosystem damage.

Particulate matter, or PM**,** is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Particulate matter is further classified as total suspended particulates (TSP), particulate matter less than 10 microns in diameter (PM_{10}) and less than 2.5 microns in diameter

($PM_{2.5}$). Particulate matter may be emitted directly to the atmosphere from mobile and stationary sources such as cars, trucks, buses, factories, construction sites, tilled fields, unpaved roads, stone crushing, and wood burning. Additionally, PM may be generated from secondary chemical reactions in the atmosphere involving oxides of nitrogen and sulfur. The primary health hazard stems from inhalation of fine particulate matter or $PM_{2.5}$. Many health studies have correlated increased $PM_{2.5}$ exposure with increases in premature death as well as a range of serious respiratory and cardiovascular effects. Environmentally, particulate matter in the form of atmospheric sulfates and nitrates, organics, and elemental carbon (soot), represents the primary source of visibility impairment and contributes to atmospheric deposition.

Lead is a metal found naturally in the environment as well as in manufactured products. The major source of lead emissions has historically been motor vehicles. However, the levels of lead in the atmosphere have decreased dramatically since 1978 due to the phase out of leaded gasoline. Currently, the highest levels of lead in the atmosphere are generally found near lead smelters, waste incinerators, utilities, and lead-acid battery manufacturers. Health effects resulting from lead exposure include damage to the liver, kidneys, brain and nervous system. The Pacific Rim Project is not expected to emit any substantial quantities of lead, and therefore is not discussed further in this document.

Hazardous Air Pollutants

Formaldehyde is an irritant to humans. Acute (short-term) and chronic (long-term) exposures can result in eye, nose and throat irritation and respiratory symptoms including coughing, wheezing and bronchitis. In addition, the Environmental Protection Agency (EPA) has classified formaldehyde as a Group A, probable human carcinogen of medium carcinogenic hazard (EPA 1994). The highest levels of airborne formaldehyde have been found in indoor air, where it is released from various consumer products (EPA 2002). One survey (EPA 1988) reports measured formaldehyde levels in homes ranging from 0.10 to 3.68 parts per million (ppm), or 122 to 4,520 $\mu g/m^3$. The smoking of tobacco products also represents an important source of human formaldehyde exposure.

Benzene emissions typically result from coal and oil combustion, volatilization from gasoline service stations, and motor vehicle exhaust. Acute inhalation exposure to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Chronic inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia. Adverse reproductive effects have been reported for women exposed by inhalation to high levels, and adverse effects on the developing fetus have been observed in animal tests. Increased incidence of leukemia (cancer of the tissues that form white blood cells) have been observed in humans occupationally exposed to benzene. EPA has classified benzene as a Group A, human carcinogen (EPA 1994).

Additional BTEX compounds including toluene, ethylbenzene, and xylene, as well as *n*-hexane, are of concern for both acute and chronic health effects. EPA has classified these compounds as a Group D, not classifiable as to human carcinogenicity (EPA 1994). These compounds are released to the atmosphere through a variety of pathways, including volatilization through their use as solvents, as fugitive emissions from industrial sources, and through automobile exhaust.

3.2.3.3 Existing Air Quality Conditions

Comprehensive air quality monitoring has not been conducted within the PRPA. However, air quality in and surrounding the area is expected to be relatively good due to the limited number of

large industrial emission sources and predominately favorable atmospheric dispersion conditions. Background values recorded in the region are below the NAAQS and WAAQS. Measured regional background concentrations are presented in Table 3-8 with the applicable ambient air quality standards.

The PRPA 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 PRPA in the Wind River Mountain Range. Contiguous with Bridger Wilderness are Popo 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 3-2 presents a regional map indicating the location of the PRPA and the areas of special concern while Table 3-7 summarizes the distances the PRPA and the areas of special concern. The applicable PSD increments for both Class I and II areas are presented in Table 3-7.

Table 3-7 Areas of Concern PSD Class I and Sensitive Class II Areas.

Area of Special Concern	Distance[1] and Direction From Pacific Rim Project Area	PSD Classification
Bridger Wilderness	125 miles North Northwest	Federal PSD Class I
Fitzpatrick Wilderness	145 miles North Northwest	Federal PSD Class I
Wind River Roadless Area	125 miles North Northwest	Federal PSD Class II
Popo Agie Wilderness	145 miles North Northwest	Federal PSD Class II
Savage Run Wilderness	120 miles West	State PSD Class I

1 - Distance from the center of the project area to the center of the area of concern.

3.2.3.4 Air Quality Related Values

Areas of special concern, including some PSD Class I areas, are monitored for Air Quality Related Value (AQRV) impacts. These AQRVs include terrestrial and aquatic deposition and visibility impairment.

<u>Atmospheric Deposition</u>

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 or kg ha^{-1}). Air pollutants are deposited by wet deposition (precipitation) and by dry deposition (gravitational settling of particles and adherence of gaseous pollutants).

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet

and dry deposition. Total terrestrial deposition voluntary guidelines have been estimated for several areas, including the Bridger Wilderness in Wyoming (Fox et al. 1989). Estimated total terrestrial deposition guidelines include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" or "level of concern" (defined as the acceptable level of total deposition).

Table 3-8. 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 [2] and Wyoming [3] Ambient Air Quality Standards ($\mu g/m^3$)	PSD [4] Class I Increment ($\mu g/m^3$)	PSD [4] 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 [1]	169 [c]	235	n/a	n/a
8-hour [5]	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 [5]	15 [d]	65	n/a	n/a
Annual [5]	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: 1 - Measured background ozone concentration value represents the top tenth percentile maximum 1-hour value. Other short-term background concentrations are second-maximum values.
2 - 40 CFR part 50 National Primary and Secondary Air Quality Standards.
3 - Wyoming Air Quality Standards and Regulations, Chapter 2 - Ambient Standards.
4 - 40 CFR part 51.166 Prevention of Significant Deterioration of Air Quality.
5 – State implementation of this standard is pending.
n/a: Not Applicable.

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)

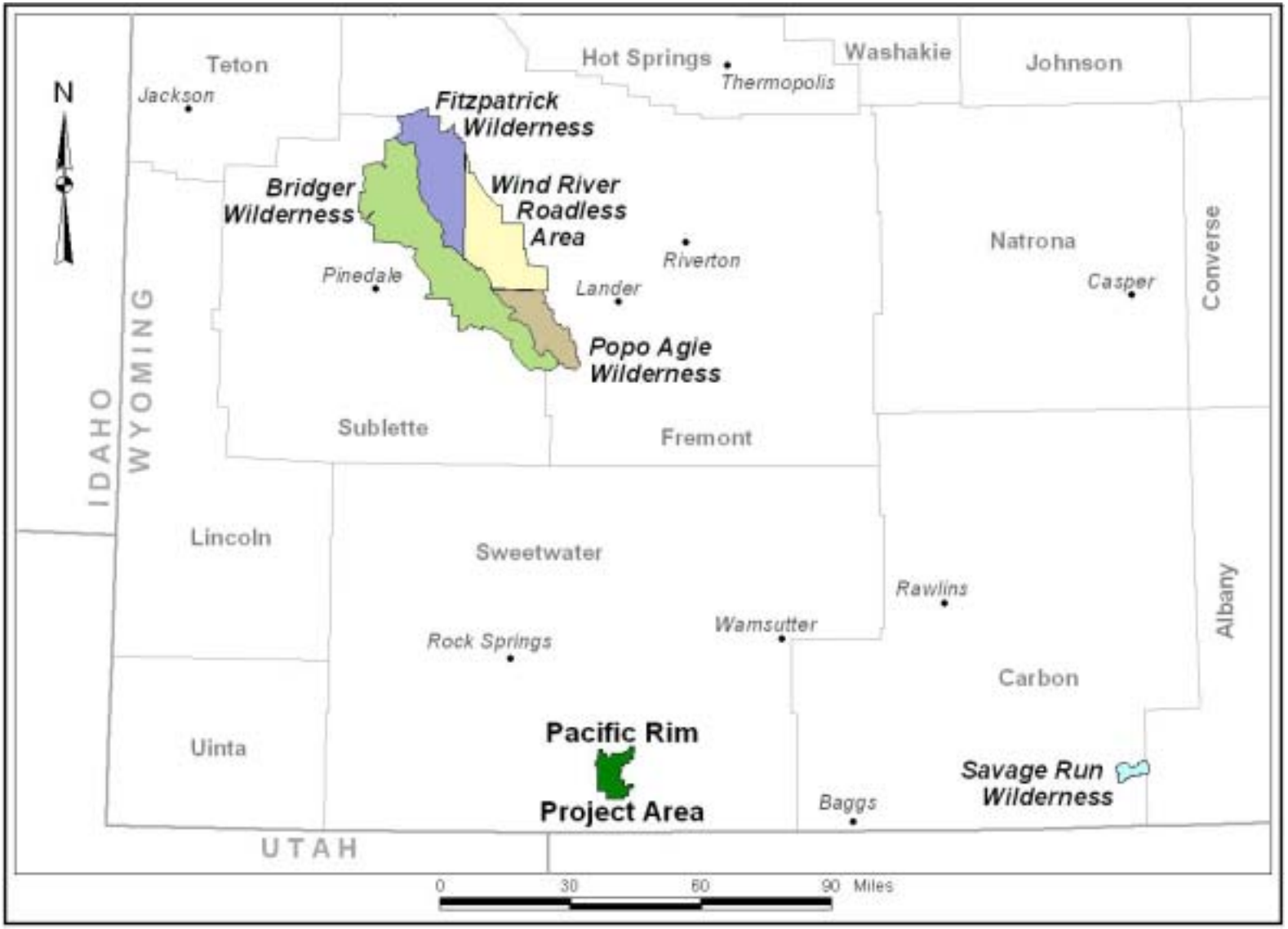
[b] Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period January-December 2001. (ARS, 2002)

[c] Data collected at Green River Basin Visibility Study site, Green River, Wyoming during the period June 10, 1998 through December 31, 2001 (ARS, 2002).

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

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

Figure 3-2. Pacific Rim Project Area and Areas of Special Concern



Total deposition guidelines for Bridger include a “red line” set at 10 kg/ha/year for nitrogen and 20 kg/ha/year for sulfur, and a “level of concern” set at 3-5 kg/ha/year for nitrogen and 5 kg/ha/year for sulfur. Air quality scientists are currently re-evaluating the thresholds, because the thresholds may be set too high.

Incremental project-level Deposition Analysis Thresholds (DATs) for Class I areas have also been proposed jointly through the National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS). The DAT is the additional amount of deposition that triggers a management concern, not necessarily the amount that constitutes an adverse impact to the environment. Both the NPS and the FWS utilize a case-by-case approach to permit review and National Environmental Policy Act (NEPA) related proposals. Adverse impact determinations are considered on a case-by-case basis for predicted deposition values that are higher than the DAT. The DAT for sulfur and nitrogen deposition in Western Class I areas, developed as a function of natural background deposition, has been set at 0.005 kg/ha/yr N or S (National Park Service 2003).

Project Area Conditions

The National Atmospheric Deposition Program (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). The NADP station closest to the Pacific Rim project area is near South Pass City, Wyoming, approximately 90 miles north northwest of the PRPA. Data are available from 1985 through 2002.

The mean annual precipitation pH recorded at the South Pass City NADP site ranges from 4.7 to 5.2. The natural acidity of precipitation is considered to range from 5.0 to 5.6 pH (Seinfeld, 1986). Annual nitrogen wet deposition rates recorded at South Pass City average 0.47 kg/ha ammonium ($NH4^+$), and 0.74 kg/ha nitrate. The annual average wet sulfate deposition rate is 0.91 kg/ha.

The Clean Air Status and Trends Network (CASTNet) measures dry deposition of nitrogen and sulfur compounds. The CASTNet station nearest to the PRPA is near Pinedale, Wyoming, approximately 130 miles northwest of the PRPA. Data are available from 1992 through 2001.

Annual dry nitrogen deposition rates recorded near Pinedale include average 0.11 kg/ha ammonium ($NH4^+$), 0.08 kg/ha nitrate (NO_3^-), and 1.97 kg/ha nitric acid (HNO_3). Annual sulfur deposition rates average 0.53 kg/ha sulfur dioxide (SO_2) and 0.28 kg/ha sulfate (SO_4).

Bridger Wilderness Conditions

In order to characterize the current deposition rates for the Bridger Wilderness area, dry and wet deposition monitoring data taken from Pinedale, Wyoming (as recommended in the FLAG [2000] Phase I report) were evaluated. Wet deposition data from Pinedale are available through the National Atmospheric Deposition Program (NADP) for the period 1982 through 2002. As previously discussed, CASTNet data for the Pinedale measurement site are available for the years 1992 through 2001.

Figures 3-3 and 3-4 present graphical representations of the Pinedale annual deposition rates, along with comparisons to the Bridger “level of concern” acceptable deposition thresholds. Note that the charts represent deposition as total nitrogen (N) or total sulfur (S). The charts present only the years for which both NADP and CASTNet are available. As the data illustrate, total background deposition of nitrogen and sulfur are below the Bridger “level of concern” thresholds, although the “level of concern” may be set to a lower value in the future.

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 can 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–FS 2000). The following Table 3-9 summarizes the background ANC values for selected lakes located in the areas of special concern. As shown, Upper Frozen Lake in the Bridger Wilderness has a low tolerance for additional acid deposition with an ANC of 5.0 micro-equivalents/liter (µeq/l). The current conditions at Upper Frozen Lake are estimated from a limited number of samples (six), that range in value from 2.6 µeq/l to 18.4 µeq/l.

Table 3-9. Background Acid Neutralization Capacity for Sensitive Lakes [1]

Lake Name	Special Concern Area	Managing Agency	Background ANC Level [2] (µeq/l)	Monitoring Period	Number Of Samples
Black Joe	Bridger Wilderness	USFS	67.0	1984 – 2003	61
Deep	Bridger Wilderness	USFS	59.9	1984 – 2003	58
Hobbs	Bridger Wilderness	USFS	69.9	1984 – 2003	65
Upper Frozen	Bridger Wilderness	USFS	5.0	1997- 2003	6
Ross	Fitzpatrick Wilderness	USFS	53.5	1988 – 2003	44
Lower Saddlebag	Popo Agie Wilderness	USFS	55.5	1989 – 2003	43

1 – Background ANC values compiled from 24 data files supplied by the USDA-FS (USDA-FS 2003).
2 - 10% lowest ANC as measured at the lake outlet.

Visibility

Visitors to national parks and wilderness areas list the ability to view unobscured scenic vistas as an important part of a satisfying experience. However, 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 2000).

Visibility is usually characterized by two parameters, visual range (VR) and the light-extinction coefficient (b_{ext}). The visual range parameter represents the greatest distance that a large dark object can be seen. The light extinction coefficient represents the attenuation of light per unit distance due to scattering and absorption by gases and particulate matter in the atmosphere. Under typical conditions, the visual range and b_{ext} parameters are inversely related to each other. Good visibility conditions are represented by long visual ranges and low b_{ext} values, while poor

visibility conditions are represented by short visual ranges and high b_{ext} values.

Figure 3-3. Nitrogen Deposition Measured At Pinedale, Wyoming

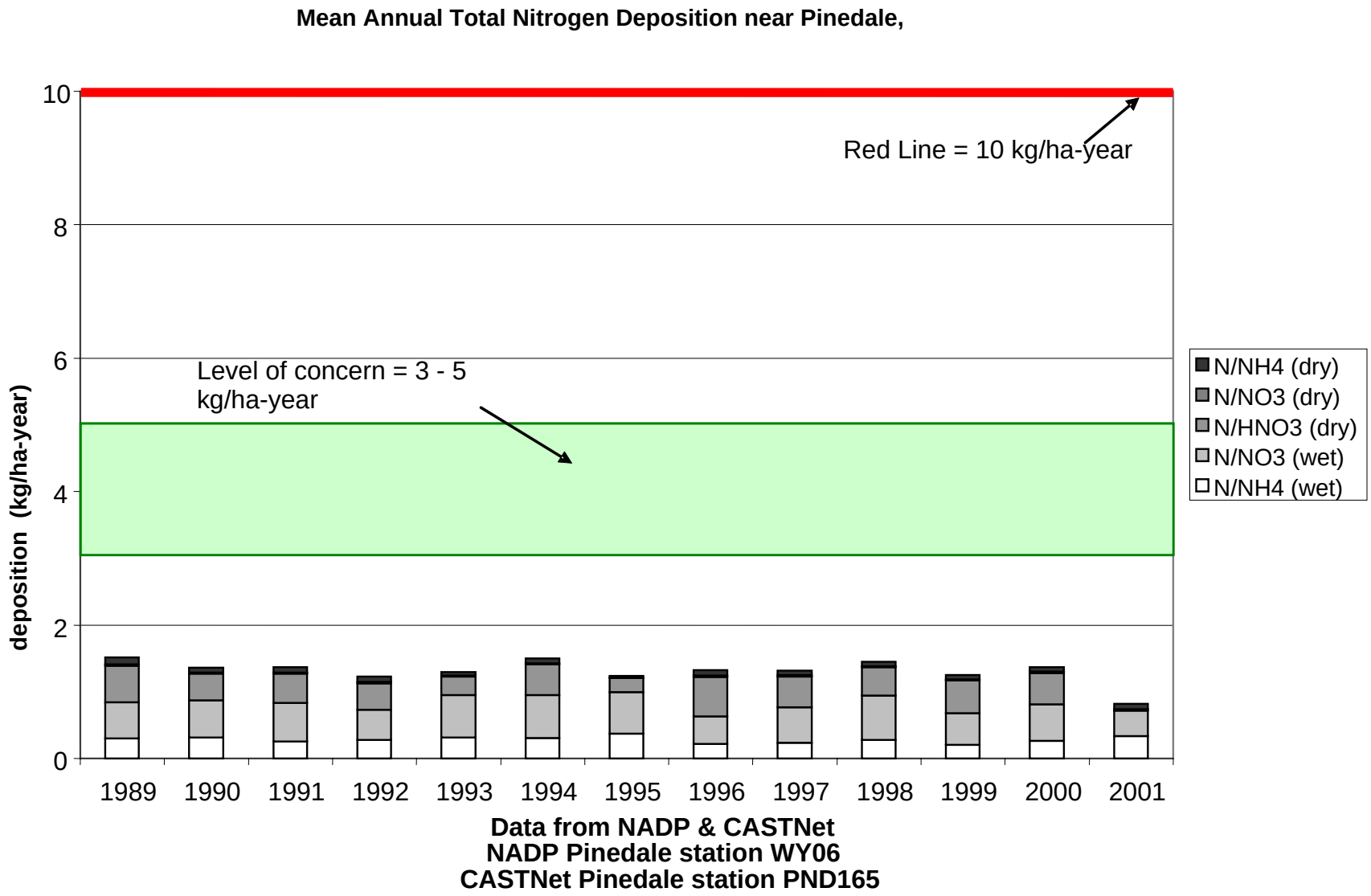
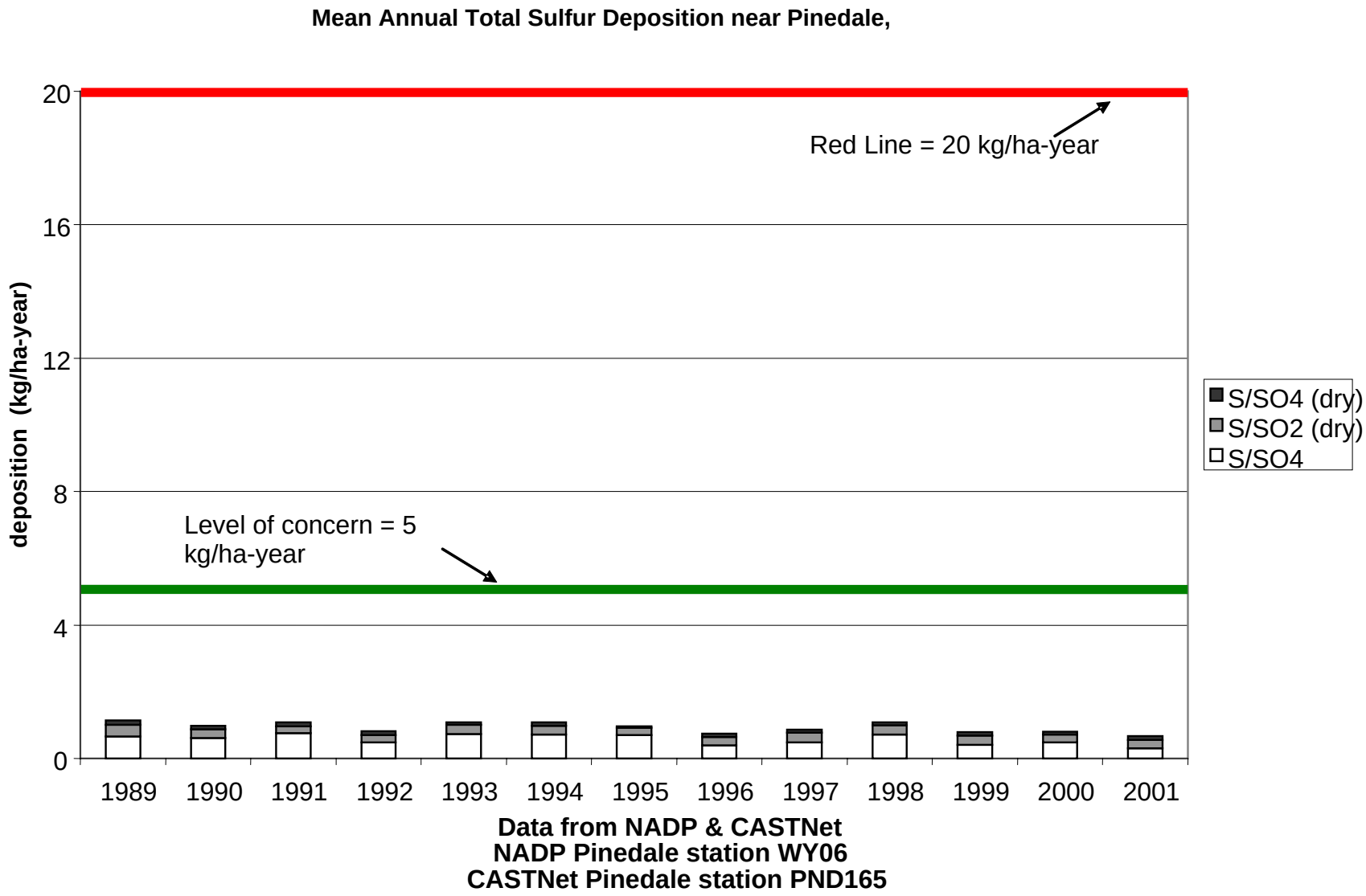


Figure 3-4. Sulfur Deposition Measured At Pinedale, Wyoming



The dimension for b_{ext} is 1/length (inverse length) and the coefficient is typically expressed as "inverse kilometers" (km^{-1}), or "inverse megameters" (Mm^{-1}), the reciprocal of 1 million meters.

Visibility impairment is frequently expressed in terms of deciview (dv). The deciview index was developed as a linear perceived visual change. Increasing deciview values represent proportionately larger perceived visibility impairments. A change in visibility of 1.0 dv represents a "just noticeable change" by the average person under most circumstances. However, when visibility conditions are very good, changes in visibility of 0.5 dv or less may be perceived 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.

Visibility related background data are collected as part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program. The nearest IMPROVE site to the PRPA is located in the Bridger Wilderness area, and data have been collected at the site since 1988.

Table 3-10 summarizes the seasonal visibility conditions recorded at Bridger Wilderness between March 1996 and February 1999. As the data illustrate, visibility conditions at Bridger Wilderness are typically very good with an average annual standard visual range (SVR) of 109 miles (175 kilometers). Visibility conditions are typically best in the winter months with an average SVR of 136 miles, and haziest in the summer with an average SVR of 101 miles.

Figure 3-6 presents the annual 20% cleanest, 20% haziest, and the mid-range 40% to 60% visibility conditions monitored at Bridger Wilderness between 1988 and 2001 (IMPROVE 2003). The 20% cleanest days represent good visibility conditions that are equaled or exceeded 20% of the time. Conversely, the 20% haziest days represent visibility conditions that are equaled or exceeded 80% of the time. As shown, monitored visibility conditions at Bridger Wilderness have been stable over the period, neither improving nor degrading. However, potential for impairment to existing visibility in the Bridger and Fitzpatrick wilderness areas, as well as in more distant Class I and II areas, has been identified as an area of potential concern associated with oil and gas development in the region.

3.3 SOILS

3.3.1 Introduction

The climate of the PRPA is that of a semiarid windy desert. The annual precipitation ranges from about 7 to 14 inches (including snowfalls), and annual temperatures vary from about -30 degrees F during the winter months, to more than 100 degrees F in summer. Sage thickets are the dominant vegetation, and this is augmented along drainages by greasewood, bunchgrass, other grasses, cactus, rabbit brush, and wildflowers. Sandstone exposures in the higher elevations commonly support cedar, juniper, and pine cover, and are host to lichen.

The PRPA is typical of a desert intermontane synclinal basin in that its physiography is dominated by: (1) hogbacks and strike valleys; and (2) alluvial deposits along the principal drainages. Strath (bedrock) and gravel/conglomerate-capped terraces do not occur in the area. This absence may be due to the overall higher elevations in the PRPA and may reflect a higher degree of ongoing downcutting by streams.

Figure 3-5. Special Concern Lake

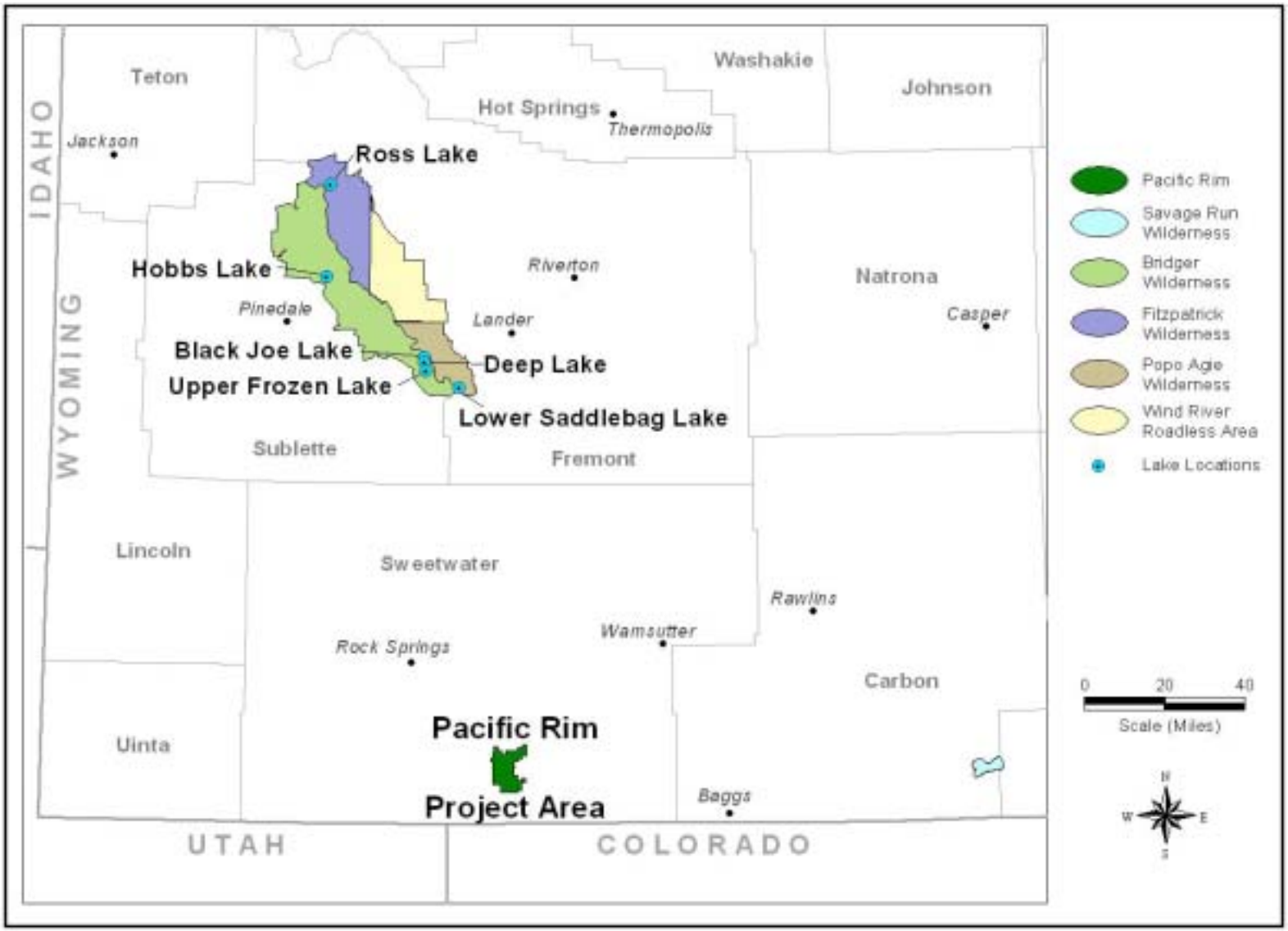


Table 3-10. Background Standard Visual Range for the Bridger Wilderness Area

Season	Standard Visual Range miles (kilometers)	Deciview (Unitless)
Annual	109 (175)	8.1
Spring	103 (165)	8.6
Summer	101 (162)	8.8
Autumn	105 (169)	8.4
Winter	136 (218)	5.9

Source: IMPROVE (2000). Data is aggregated over the three-year period between March 1996 and February 1999.

3.3.2 Topography

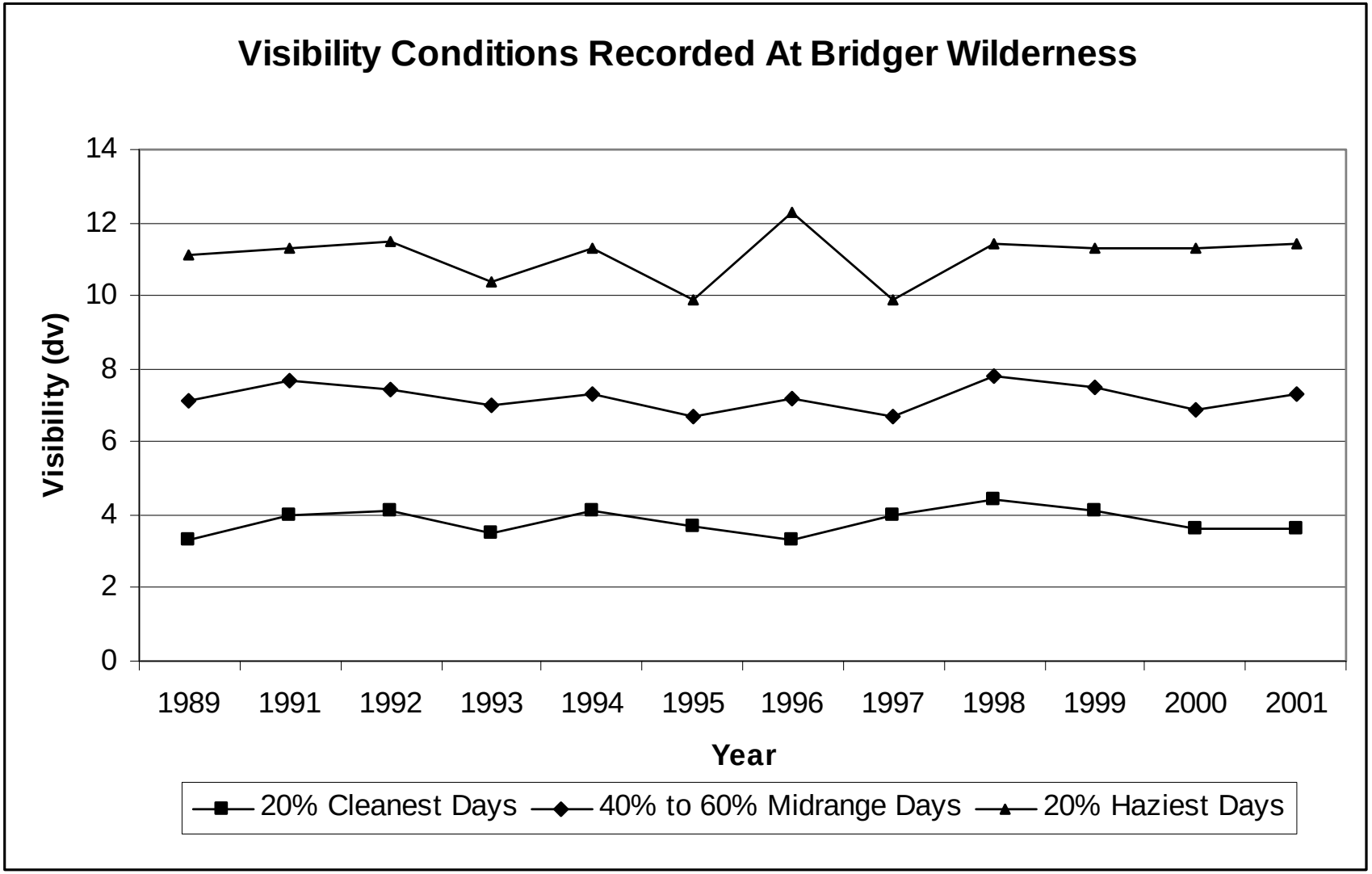
The topography within the PRPA varies from nearly flat alluvial bottom lands in and bordering the drainages of East Salt Wells Creek and Scheggs Draw to moderate to steep ridges and cliffs along Rifes Rim to the south and east. Steep terrain is also present in the central part of the area along the edges of thick fluvial sandstone channels preserved in the Fort Union and Wasatch Formations. South and east of Rifes Rim gently sloping and rolling terrain is developed in the Tipton and Wilkins Peak members of the Green River Formation Relief within the PRPA totals 954 feet. The highest elevation is 7,950 feet on the west side of Kinney Rim in the NE most corner of Section 8, T15N, R100W (Pine Butte Quadrangle). The lowest point (6,877 feet) lies in alluvium in the valley of East Salt Wells Creek, in the SW1/4 Section 18, T15N, R101W (Burley Draw Quadrangle).

Principal streams draining the PRPA include East Salt Wells Creek and Scheggs Draw, which drain northward, Alkali Creek and Granary Draw, as well as other unnamed upper tributaries of Vermillion Creek, which drains southward. All of these drainages, are ephemeral spring or runoff-fed streams that are actively down cutting into the alluvium of their floodplains and originate in areas chiefly underlain by easily weathered and eroded bedrock sandstone, shale, and mudstone. East Salt Wells Creek essentially bounds the western margin of the area and Rifes Rim forms the drainage divide between north draining and south draining streams.

3.3.3 General Soil Characteristics

Soil parent materials in the project area include: (1) thin sandstones and thicker shale sequences of the lacustrine Niland Tongue of the Green River Formation (middle Eocene); and (2) the largely fluvial and paludal (marshy) sandstones, mudstones, shales, and coals of the Paleocene Fort Union Formation and the Main Body of the lower Eocene Wasatch Formation. Slopewash debris and alluvium derived from these units also constitute parent materials for PRPA colluvial and alluvial soils, with the relative proportions of relatively sandy or clay-rich parent materials dependent on the dominant composition of local outcrop rocks. Small swatches of stabilized sand dunes also occur locally as loess hills in the east-central part of the project area, and the upper (A) horizons of nearly

Figure 3-6. Visibility Conditions Recorded at Bridger Wilderness



every soil--excluding Bedrock soils--were found to contain an appreciable percentage of fine sand of probable eolian (windblown) origin.

3.3.3.1 Geomorphic Setting, Soil Texture and Slope

In the absence of detailed baseline soils information, site-specific data was gathered from the field. Soils of the PRPA were grouped according to geomorphic setting and six broad soil categories are recognized. These include: (1) Bedrock; (2) Mixed Residual Colluvial Soils and Bedrock Soils; (3) Upland Slope Soils; (4) Upper Alluvial Bottomland Soils; (5) Lower Alluvial Bottomland Soils, and (6) Loess Soils (Figure 3-7).

Soil textures consist of sandy loams, sandy clay loams, clay loams, sandy loam, and sandy clays, and are best developed in Alluvial Bottomland Soils and Upland Slope SoilsCthe soils which occur in areas with minimal slope. Mixed Residual Colluvial Soils and Bedrock 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. Bedrock includes bare exposed rock outcrop, as well as areas lacking soil development. Bedrock exposures grade imperceptibly into Mixed Residual Colluival and Bedrock Soils.

3.3.3.2 Soil Depth

All soils in the PRPA are shallow (less than 24 inches in total thickness), their combined A (top) and B (subsurface) horizons measuring from only 7 to 23 inches in thickness. The thickest soils are the Loess Soils (23 inches) and the thinnest (excluding Mixed Residual Colluvial and Bedrock Soils) are the Upland Slope Soils (6-7.5 inches depth). In test pits Alluvial Bottomland Soils and Upland Slope Soils exhibit effective rooting into the top of the C (unweathered parent material) horizon.

3.3.3.3 Soil Permeability and Erosion Potential

The majority of soils in the PRPA 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 eolian (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 Loess soils and the high percentage of eolian (wind-blown) sandCespecially prevalent in the Upland Slope SoilsCis 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 significantly 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. Deep gullying was only observed in Section 19, T14N, R101W, in an unnamed tributary of East Draw, near where it joins East Salt Well Creek. Here erosion has down cut more a gully exceeding 10 feet deep and a few feet to more than 10 feet wide.

Erosion may be accelerated by surface disturbance such as the blading off of vegetation and of the very shallow yet more permeable A horizons of the soils. However, because all soils in the PRPA are shallow (less than 24 inches, 60 cm depthCmaximum 18 inches, 45 cm), it is probable that most blading will completely remove the topsoil and expose bedrock. Exposed bedrock 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.

3.3.4 Site Specific Soil Characterizations

Site specific field investigation of soils in the PRU were undertaken to determine soil characteristics such as horizonation, 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.

Erosional dissection has resulted in a profound ridgeline hogback and steep-sloping strike valley topography. ***Bedrock Soils*** are simply exposures of relatively unaltered bedrock of the Fort Union, Wasatch, and Green River formations. These thin soils grade imperceptibly into ***Residual Colluvial Soils*** commonly surround exposures of Bedrock Soils, and represent Bedrock that has been deeply weathered or broken up and dislodged by gravity, or both, from *in situ* rock. For the purposes of soil mapping, several large areas of Bedrock Soils are readily identifiable; however in many areas it is impossible to separate tracts of Bedrock Soils from those of Residual Colluvial Soils without extensive and detailed. For this reason, tracts of undifferentiated Residual Colluvial Soils and Bedrock Soils were mapped as ***Residual/Bedrock Soils***. ***Upland Slope Soils*** occur on relatively gently sloping surfaces and the uppermost parts of strike valleys. Soils on alluvium in the tributary drainages of the principal local stream (East Salt Wells Creek) are identified as ***Upper Alluvial Bottomland Soils***, and soils on alluvium in the valley of East Salt Wells Creek are identified as ***Lower Alluvial Bottomland Soils***. The Lower Alluvial Bottomland Soils formed on unconsolidated parent materials derived from the mixture of sediments from the tributary drainages to East Salt Wells Creek, and are commonly typified by a considerable thickness (in places exceeding 20 feet) of superposed soils. In contrast, the parent materials of the Upper Alluvial Bottomland Soils have a more restricted (more localized) origin. ***Loess Soils*** (**LS** on map) are developed on restricted areas of sand dunes that have been stabilized by vegetation.

1. *Bedrock Soils (BR)*

> *Unweathered to only slightly weathered* in situ *bedrock, including sandstones, mudstones, shales, thin limestones, carbonaceous shales, and coals of Fort Union, Wasatch, and Green River Formations. These soils occur at elevations of 6,970 to 8,040 feet, and on gradients of 0-16% slope. No sites were analyzed.*

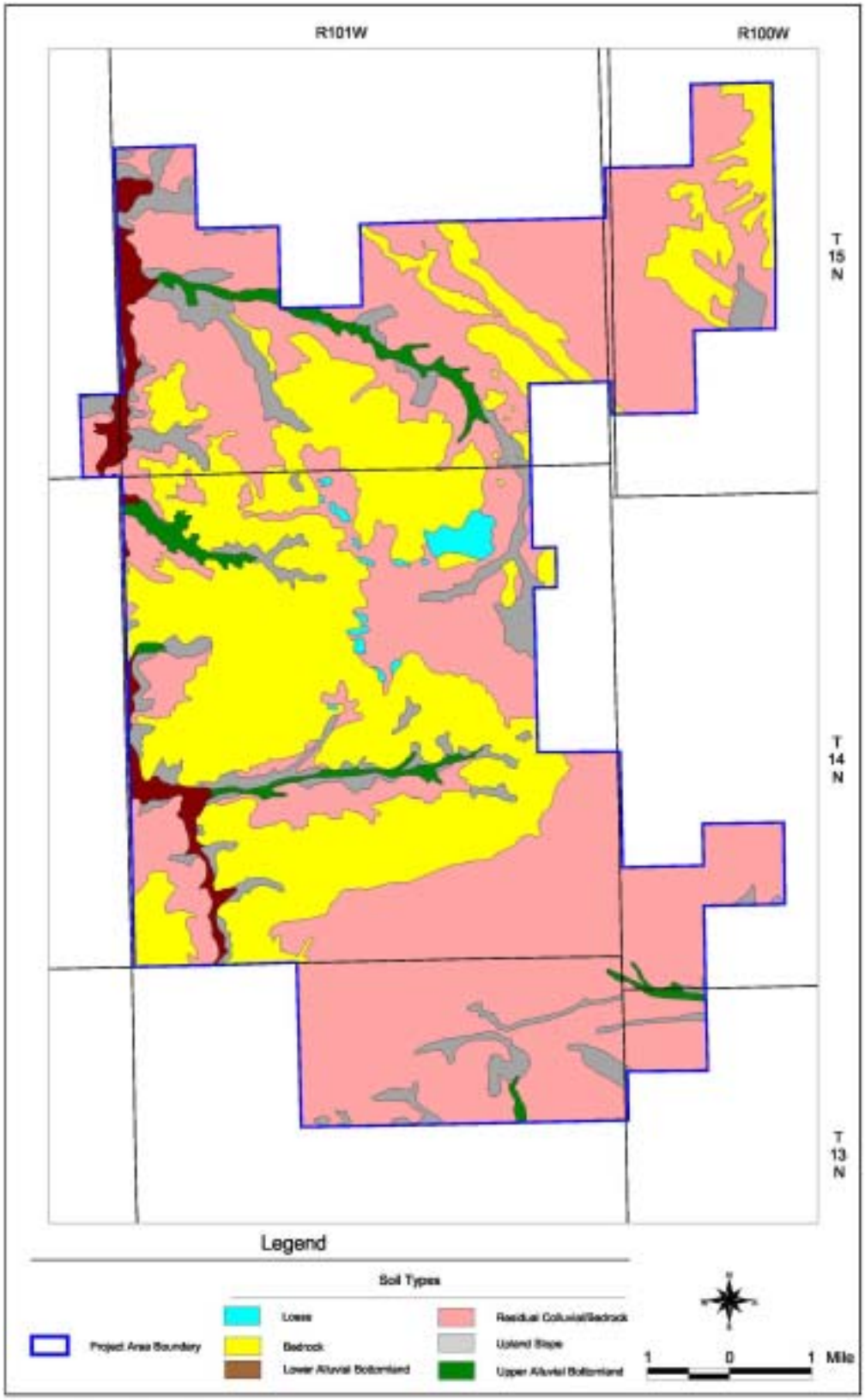


Figure 3-7. Soil Types in the PRPA.

2. *Mixed Residual Colluvial Soils and Bedrock Soils (R/BR)*

Residual Colluvial component of these soils consists of shallow soils on gentle to relatively steep slopes (0-7%), generally poorly-drained and occurring at elevations of 6,900 to,7,820 feet. Residual Colluvial Soils range from "popcorn"-like crusts on mudstones and powdering of shales to slope accumulations of brecciated sandstone fragments ranging from pebble to boulder in size. Most of these soils, however, occur as thin zones of weathered, dislodged, or partially disaggregated bedrock.

SITE PR-4

UTM Zone 12: 687770E, 4555856N; Erickson-Kent Ranch Quadrangle
SLOPE: 0-1%
ELEVATION: 7,460 feet
PARENT MATERIAL: Shale in Niland Tongue of Wasatch Formation
PHYSIOGRAPHY: Top of hogback
SOIL THICKNESS: 18 cm

A = Clay loam, highly calcareous, 10YR6/3 (pale brown); pH = 7.0; 6 cm; Completely unconsolidated flaky sediment with shale chips as residual lag on surface; some admixture of aeolian sand

Bw = Sandy Clay Loam, very calcareous, 10YR5/4 (yellowish-brown); PH = 7.9; 12 cm

C = Weathered Shale

3. *Upland Slope Soils (US)*

Shallow to moderately deep soils on gentle to moderate (0-5%) slopes, very permeable and well-drained. Calcareous, generally base-neutral loamy sands, sandy loams, and sandy clay loams developed on sloping surfaces of the Fort Union, Wasatch and Green River formations at elevations of 6,875 to 7,450 feet.

SITE PR-3

UTM Zone 12: 683084E, 4563272N; Erickson-Kent Ranch Quadrangle
SLOPE: 2-5%
ELEVATION: 7,150 feet
PARENT MATERIAL: Sandstones and mudstones of Fort Union Formation
PHYSIOGRAPHY: Slope at head of draw
SOIL THICKNESS: 41+ cm

A = Sandy Loam, moderately calcareous, 10YR6/1 (gray); pH = 7.5;
8 cm. Granular texture, some fine aeolian sand

Bw = Loamy Sand, moderately calcareous, 10YR5/2 (grayish-brown);
PH = 7.6; 23 cm

Btk = Sandy Loam, very calcareous, 10Y5/3 (brown); pH = 7.6; 10+ cm.
$CaCO_3$ pisoliths

4. Upper Alluvial Bottomland Soils (UA)

Relatively shallow soils on gentle (0-2.5%) slopes, generally poorly drained to moderately permeable, moderately calcareous to very calcareous, base neutral sandy clay loams and sandy clay developed on alluvium of tributary streams at elevations of 6,890 to 7,300 feet.

SITE PR-1

UTM Zone 12: 688398E, 4567520N; Erickson-Kent Ranch Quadrangle
SLOPE: 0-2%
ELEVATION: 7,150 feet
PARENT MATERIAL: Mixed Alluvium, moderately permeable
PHYSIOGRAPHY: Tributary drainage to East Salt Wells Creek
SOIL THICKNESS: 35+ cm

A = Sandy Clay Loam, very calcareous, 2.5Y7/2 (light gray); pH = 7.2; 7 cm. Probably largely eolian

Bt = Sandy Clay, very calcareous, 2.5Y6/3 (light yellowish-brown); pH = 7.2; 18 cm

Bt2K = Sandy Clay, highly calcareous, 2.5Y6/2 (light brownish-gray); pH = 7.5; 10+ cm

5. Lower Alluvial Bottomland Soils (LA)

Shallow to moderately deep multiple soils lying on gentle (0-1%) slopes, permeable at surface but drain poorly at depth. Moderately calcareous to very calcareous base neutral sandy clays, sandy clay loams, and clay loams developed on thick alluvium of principal ephemeral stream at elevations of 6,877 to 7,340 feet.

SITE PR-2

UTM Zone 12: 683084E, 4563272N; Erickson-Kent Ranch Quadrangle
SLOPE: 0-1%
ELEVATION: 6,895 feet
PARENT MATERIAL: Mixed alluvium from contributory tributary drainages
PHYSIOGRAPHY: Low-lying alluvial bottomland
SOIL THICKNESS: 55+ cm

A = Sandy Clay Loam, very calcareous, 2.5Y7/3 (pale yellow); pH = 7.5; 5 cm

Bw = Sandy Clay Loam, moderately calcareous, 2.5Y6/3 (light yellowish -brown); pH = 7.6; 20 cm

Btk = Clay Loam, highly calcareous, 2.5Y6/3 (light yellowish-brown); pH = 7.5; 30+ cm. Tiny $CaCO_3$ pisoliths, rooted to base of profile

6. Loess Soils (LS)

Multiple soils of moderate thickness on gentle to moderate (1-5%) slopes. Well-drained and highly permeable with low runoff potential; noncalcareous, pH neutral fine sands, loamy sands, and sandy

loams developed on vegetation-stabilized sand dunes at elevations of 7,000 to 7,650 feet. Buried horizons of older loess soils evident in a few localities.

SITE PR-5

UTM Zone 12: 688275E, 4565048N; Erickson-Kent Ranch Quadrangle
SLOPE: 3%
ELEVATION: 7,420 feet
PARENT MATERIAL: Aeolian Sand
PHYSIOGRAPHY: Atop beveled hogback ridge of Main Body of Wasatch Formation
SOIL THICKNESS: 58+ cm

A = Fine Sand, noncalcareous, 10YR4/4 (dark yellowish-brown); pH = 7.5; 6 cm

Bt = Loamy Sand, noncalcareous, 10YR3/4 (dark yellowish-brown); pH = 7.5; 32 cm

Bt2 = Sandy Loam, noncalcareous, 10YR4/4 (dark yellowish-brown); pH = 7.6; 20+ cm

3.3.5 Biological Crusts

Vegetation cover in the arid and semi-arid lands comprising the PRPA is sparse in many places; however in open spaces between higher plants, the soil surface may not be as barren as it appears. Instead of being barren these areas may be covered by a community of highly specialized organisms known as biological soil crusts, or cryptogamic, cryptobiotic, microbiotic, or microphytic soil crusts.

Biological soil crusts are a complex mosaic of cyanobacteria, green algae, lichens, mosses, microfungi, and other bacteria. Soil crusts are concentrated in the top 1/8 inch of the ground surface, they primarily affect processes that occur at the soil surface or soil-air interface, including soil stability, erosion potential, atmospheric N-fixation, nutrient contributions to plants, soil-plant-water relations, infiltration, seeding germination, and plant growth. 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 (Belnap et al. 2001).

Baseline studies of the presence, extent, and development of biological soil crusts are lacking for most rangelands in Wyoming, including the PRPA. In areas like the PRPA that have been heavily grazed by wild and domestic animals, as well as being subject to strong winds, and other disruption biological crusts may be restricted to protected areas such as under heavy vegetation and other inaccessible areas.

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 within the Salt Wells Creek and Vermillion Creek watersheds. Salt Wells Creek, an intermittent stream, is a major tributary to Bitter Creek, also an intermittent stream and a major tributary to the Green River in the Colorado River watershed. Vermillion Creek, a perennial stream, is also a major tributary to the Green River in the Colorado River watershed. Headwaters of ephemeral tributaries of Salt Wells Creek and Vermillion Creek originate in the project area. No naturally occurring seeps and springs have been identified 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 largely dependent on climate, soils, and structural geology.

3.4.1 Precipitation and Climate

Climatological data from the Rocks Springs Airport (Station No. 487845, 1948-2003) and Bitter Creek 4 NE (Station No. 480761, 1962-2003) weather stations are most relevant to the characterization of water resources in the project area. The Rock Springs Airport, a comprehensive recording weather station, is located approximately 25 miles to the northwest at an elevation of 6,741 feet. Complete meteorological measurements are also recorded at the Bitter Creek station, located approximately 25 miles to the northeast at an elevation of 6,693 feet.

Climate. The project area occurs in a continental dry, cold-temperature-boreal climate (Trewartha 1968). This climate is primarily characterized by a deficiency of precipitation (i.e., evaporation exceeds precipitation), and generally has cold temperatures where fewer than eight months of the year have an average temperature greater than 50° degrees Fahrenheit (°F) with hot summer days and cool summer nights, but bitterly cold winters.

Temperature. The average annual temperature is 42.8°F at the Rock Springs Airport and 41.5°F at Bitter Creek. At the Rock Springs Airport, the average monthly low and high temperatures for January are 11.3°F and 29.1°F, respectively. At Bitter Creek, the average monthly low and high temperatures for January are 7.7°F and 32.2°F, respectively. In contrast, the average monthly low and high temperatures for July at the Rock Springs Airport are 53.2°F and 83.1°F, respectively, and at Bitter Creek the average monthly low and high temperatures for July are 46.7°F and 84.1°F, respectively. At the Rock Springs Airport, the average number of days per year with a minimum temperature at or below 32°F is 196.2, and the average number of days per year with a maximum temperature at or above 90°F is 5.7. At Bitter Creek, the average number of days per year with a minimum temperature at or below 32°F is 226, and the average number of days per year with a maximum temperature at or above 90°F is 6.8 (WRCC 2003).

Precipitation. Mean annual precipitation is expected to range from approximately six to nine inches in the project area, with the Rocks Springs Airport and Bitter Creek and stations having an annual average of 8.86 inches and 6.30 inches, respectively. Precipitation is somewhat evenly distributed throughout the year with a peak in May. At the Rock Springs Airport, the average monthly precipitation for the month of May is 1.21 inches. At Bitter Creek, the average monthly precipitation for the month of May is 1.09 inches (WRCC 2003). The majority of precipitation falls as rain from frontal systems and thunderstorms. In regard to 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 these two weather stations (WRCC 2003). Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter.

Other Climate Characteristics. 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

Surface water is relatively rare or infrequent within the project area. As shown in Figure 3-8, numerous ephemeral stream channels, both named and unnamed, 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 within the Bitter Creek drainage basin (USGS Basin #14040105) and Vermillion Creek drainage basin (USGS Basin #14040109). 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 (approximately 2,200 square miles) discharges into the Green River near the town of Green River, Wyoming. Vermillion Creek flows south out of Wyoming into Colorado and is considered a perennial stream that carries water continuously throughout its course. The Vermillion Creek watershed (approximately 1,000 square miles) discharges into the Green River near the Gates of Lodore, Colorado. The Green River flows into the Colorado River, which ultimately flows to the Pacific Ocean.

The project area is drained primarily by East Salt Wells Creek (approximately 175 square miles), an ephemeral tributary of Salt Wells Creek (approximately 525 square miles), which is a sub-watershed of Bitter Creek. Salt Wells Creek is predominantly an intermittent stream. Alkali Creek and its tributaries Chicken Creek and Granary Draw drain the eastern edge of the project area, while some unnamed ephemeral tributaries of North Fork Vermillion Creek drain the southern portion of the project area. Alkali Creek (approximately 115 square miles) and North Fork Vermillion Creek (approximately 83 square miles) combine to form Vermillion Creek (Figure 3-8). Alkali Creek and all its tributaries are considered ephemeral streams, while North Fork Vermillion Creek is considered a perennial stream. Numerous springs located in the headwaters area of North Fork Vermillion Creek and its tributary, Coyote Creek, as well as appreciable snow accumulation in these headwater areas, which are in excess of 7,000 feet, account for a significant contribution to North Fork Vermillion Creek's annual runoff. There are no internally drained areas in the project area.

Some shallow, small ponds or reservoirs exist along a few of the ephemeral drainages within the project area. These ponds (shown on Figure 3-8) were constructed to contain surface runoff to be used for livestock watering. Water levels in these ephemeral ponds are erratic and typically fluctuate in response to the frequency of runoff events. Numerous small springs have been identified within the North Fork of Vermillion Creek watershed (shown on Figure 3-8), particularly near the headwaters area of the stream's main stem and its tributary, Coyote Creek. No flowing wells or springs have been identified to contribute flow within any of the ephemeral stream channels in the project area.

Flow within the stream channels in the project area 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 USGS'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 in the project area 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 Salt Wells Creek may exhibit intermittent flow in one section of the channel and ephemeral flow in another section.

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

- USGS Station 09235300, Vermillion Creek near Hiawatha, Colorado, was maintained from 1975 through 1981. This site was located immediately downstream of the confluence between Alkali Creek and North Fork of Vermillion Creek, and roughly one mile north of the Wyoming-Colorado border. The mean daily streamflow values for the entire data record at this location range from 0.45 cubic feet per second (cfs) (in September) to 31.9 cfs (in April). The mean annual streamflow recorded at this location ranged from 1.88 cfs (in 1978) to 7.12 cfs (in 1980). Instantaneous peak discharges recorded at this site ranged from 458 cfs (in 1979) to 602 cfs (in 1981).

- USGS Station 09216750, Salt Wells Creek near Salt Wells, Wyoming, was maintained from 1975 through 1981. This site was located immediately upstream of Salt Wells Creek's confluence with Bitter Creek. The mean annual flow recorded at this location ranged 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). For the five years of record obtained at this site, the average runoff for Salt Wells Creek was 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 the 1962 flood event resulted from a rain on snow pack (Lowham et al. 1982).

- USGS Station 09216565, Salt Wells Creek near South Baxter, Wyoming, was maintained from 1976 through 1981. This site was located more that 11 miles upstream of East Salt Wells Creek's confluence with Salt Wells Creek. Streamflow records indicate that the reach of Salt Wells Creek near this site appeared to be intermittent. Like the North Fork of Vermillion Creek, numerous springs contribute low flows from groundwater inflows; however, evapotranspiration, freeze up, and seepage deplete these flow so that downstream, the stream has only intermittent flows (Lowham et al. 1982). Instantaneous peak discharges at this site ranged from 13 cfs (in 1979) to 42 cfs (in 1981). The mean annual flow recorded at this location ranged from 0.55 cfs (in 1977) to 2.26 cfs (in 1980).

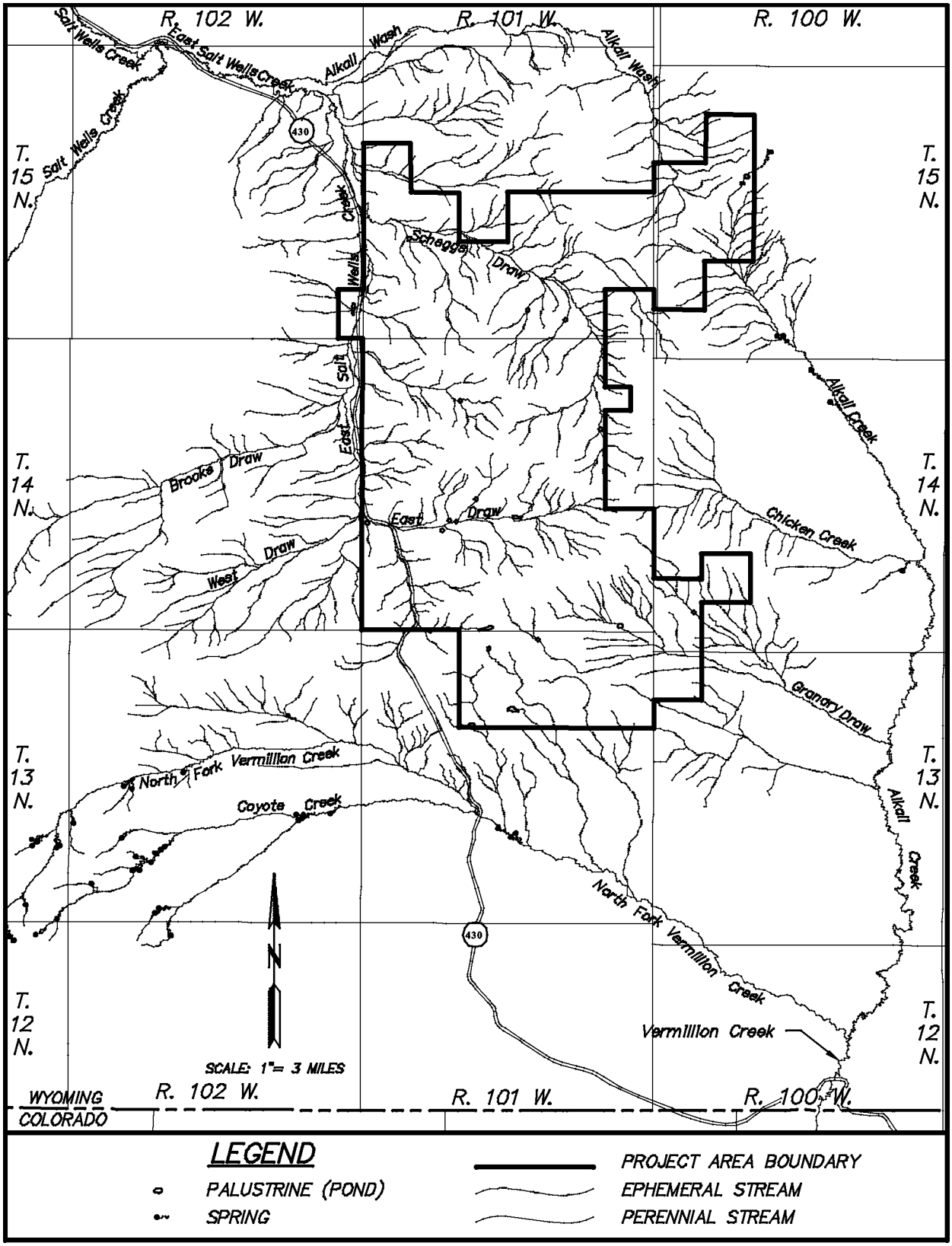

R. 102 W.
R. 101 W.
R. 100 W.
T. 15 N.
T. 14 N.
T. 13 N.
T. 12 N.
Salt Wells Creek
East Salt Wells Creek
Alkali Wash
Alkali Wash
430
Salt Wells Creek
Schegge Draw
East Salt Wells Creek
Brooks Draw
West Draw
East Draw
Alkali Creek
Chicken Creek
Granary Draw
North Fork Vermillion Creek
Coyote Creek
Alkali Creek
North Fork Vermillion Creek
Vermillion Creek
SCALE: 1"= 3 MILES
WYOMING
COLORADO
LEGEND
PALUSTRINE (POND)
SPRING
PROJECT AREA BOUNDARY
EPHEMERAL STREAM
PERENNIAL STREAM

Figure 3-8. Surface Water Features in the PRPA.

- The USGS maintained crest stage gages at Station 09216580, (Big Flat Draw near Rock Springs, Wyoming) from 1973 through 1981. Instantaneous peak discharges at this site, located at the mouth of Big Flat Draw, ranged from 11 cfs (recorded September 10, 1975) to 217 cfs (recorded August 19, 1979). Big Flat Draw has a drainage area of approximately 20 square miles. No portion of the Big Flat Draw watershed overlaps the project area, although its streamflow records represent the nature of flood runoff events resulting from rainstorms in the general area.

- 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 immediately upstream of the Salt Wells Creek confluence, ranged 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).

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), which is located approximately 15 miles north of the project area, 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 (December 2003) review of the Wyoming State Engineer's Office (SEO) records, there are currently 10 active surface water rights in the project area. Eight of these water rights are reservoirs and permitted for livestock use. Two other surface water rights exist within the project area, although they are temporary rights to use surface water hauled from Salt Wells Creek for oil and gas drilling.

3.4.2.2 Surface Water Quality

There are no established surface water quality sampling stations located within the project area, although 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. In addition, the USGS and USDI-BLM have collected numerous miscellaneous surface water quality samples in the Bitter Creek and Vermillion Creek watersheds outside of the Pacific Rim project area that will also be discussed.

Surface water quality in semiarid regions varies seasonally and is 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 Creeks), 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 a significant affect on the water quality of the perennial streams (i.e., Green River) receiving such runoff (Lowham et al. 1982).

The USGS (Lowham et al. 1982) reported increasing dissolved solids concentrations in the downstream direction are typical of Salt Wells Creek during runoff events. Total dissolved solids (TDS) concentrations in the headwaters, where there are numerous small springs that contribute perennial groundwater inflow, are typically less than 100 milligrams per liter (mg/L), whereas TDS concentrations downstream at USGS Station 09216750 (Salt Wells Creek near Salt Wells, Wyoming) commonly exceed 3,000 mg/L. Concentrations of the major dissolved inorganic constituents in Salt Wells Creek, with the exception of bicarbonate and carbonate, increase in the downstream direction.

Lowham et al. (1982) reported large concentrations (sometimes exceeding 100,000 mg/L) of total suspended solids (TSS), or sediment, result from the flushing phenomena in Salt Wells Creek. 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 Station 09216562 (Bitter Creek above Salt Wells Creek Near Salt Wells, Wyoming) from 1975 through 1981 (USGS 2003). Streamflow recorded at this site was discussed previously in the Surface Water Quantity section. 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 mg/L.

The USGS collected miscellaneous TSS samples at Station 09216580, Big Flat Draw near Rock Springs, Wyoming, in 1976 and 1977. A range of instantaneous peak discharges recorded at this site from 1973 to 1981 is presented in the Surface Water Quantity section. 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 USGS and USDI-BLM collected numerous miscellaneous grab samples within the Vermillion Creek watershed in the mid- to late-1970s, particularly in the headwaters area where streamflow is more consistent throughout the year due to the presence of numerous small springs contributing groundwater inflow. As depicted in Figure 3-8, no springs are identified within the Vermillion Creek watershed that drains the project area. None of these miscellaneous surface water quality grab samples were collected from within the project area. In addition, none of these grab samples were collected during high flow or flood events, but rather, were collected during low or base flow periods.

Like Salt Wells Creek, increasing TDS concentrations in the downstream direction are typical of North Fork Vermillion Creek. TDS concentrations of grab samples collected from North Fork Vermillion Creek and its tributaries at numerous locations upstream of the WYO 430 bridge (Figure 3-8) were relatively low, typically ranging from around 100 to 500 mg/L, while the TDS concentration of samples collected downstream of the highway crossing were somewhat higher, generally ranging from 500 to 1,000 mg/L. The streams' discharge, measured at the time these grab samples were collected, was usually less than 1.0 cfs. The pH was typically between 8.0 and 9.0, and the TSS concentration was generally no greater than 500 mg/l (USGS 2003, WRDS 2003).

Only one surface water quality sample is recorded as having been collected from Alkali Creek. The USGS collected a single grab sample in March 1978 just upstream of Alkali Creek's confluence with North Fork Vermillion Creek. The discharge was measured at 0.26 cfs, the field pH was 8.2, the TDS concentration was 3,060 mg/L, and the TSS concentration was 359 mg/L (WRDS 2003).

The water quality of Vermillion Creek was monitored by the USGS at Station 09235300 (Vermillion Creek near Hiawatha, Colorado) from 1975 through 1981 (USGS 2003). As discussed in the Surface Water Quantity section, Station 09235300 was located immediately downstream of the Alkali Creek and North Fork of Vermillion Creek confluence, and streamflow was also monitored continuously at that station during that same time period. 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 185 to 2,560 mg/L, the average concentration was 1,226 mg/L, and the median concentration was 1,130 mg/L. The TSS concentration ranged from 9 to 13,200 mg/L, the average concentration was 1,238 mg/L, and the median concentration was 256 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 it 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 significant 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.

East Salt Wells Creek and Alkali Creek are designated by WDEQ as Class 3 streams. Vermillion Creek, North Fork Vermillion Creek, and Coyote Creek are designated as Class 2 streams. All other ephemeral streams in the project area (i.e., named and unnamed tributaries of East Salt Wells Creek, Alkali Creek, and North Fork Vermillion Creek) are undesignated and by default take on the classification of the first stream they run into. Therefore, tributaries of East Salt Wells Creek and Alkali Creek are all Class 3 streams and tributaries of North Fork Vermillion Creek are Class 2 streams.

The WGFD has also classified surface waters in regard to the quality of trout fishery habitat and/or the importance of the trout fishery resource provided by the surface water bodies. All streams within the Bitter Creek drainage basin are Class 5 streams (very low production waters -- often incapable of sustaining a trout fishery) (WGFD 1991). All streams within the Vermillion Creek drainage basin in Wyoming, with the exception of the North Fork Vermillion Creek above the Coyote Creek confluence, are also Class 5 streams. North Fork Vermillion Creek above the Coyote Creek confluence is a Class 3 trout stream (important trout waters – fisheries of regional importance) (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.

Waters of the U.S. is a collective term for all areas subject to regulation by the U.S. Army Corps of Engineers (COE) under Section 404 of the Clean Water Act. 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 COE and U.S. Environmental Protection Agency (EPA). 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. As described previously, many of the ephemeral drainage channels within the project area identified on USGS topographic maps are vegetated swales, which are not considered to be Waters of the U.S. by the COE. 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 and springs 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 (WDEQ) mining permit (BBCC 1998).

3.4.3.1 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 and southeastward 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). 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 and southeastward 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 snow melt). 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 significant (Welder and McGreevy 1966).

Several rock units can be classified as water-bearing zones (aquifers) within the Washakie structural basin and the Rock Springs Uplift of southwest Wyoming. As described in Table 3-11, these aquifers vary in thickness, potential well yields, and water quality. The formations highlighted in Table 3-11 are those encountered within the project area to a depth of approximately 10,000 feet below land surface. The exposed geologic units within the project area are the Tipton Tongue of the Green River Formation, the Cathedral Bluffs Tongue of the Wasatch Formation, the main body of the Wasatch Formation, and the Fort Union Formation. The Tertiary-age Wasatch and Fort Union 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 described as all the water-bearing strata between the Laney Shale Member of the Green River Formation and the Fox Hills Sandstone, inclusive. The Tertiary aquifer system is the most extensively distributed and accessible source of groundwater in the Washakie and Great Divide Basins, and the total estimated use of groundwater in that area is between 80,000 and 89,000 acre-feet per year (Collentine et al. 1981).

The Tipton Tongue of the Green River Formation consists of thin-bedded shale, claystone, mudstone, and siltstone with occasional thin limestone, sandstone, and coal (Welder and McGreevy 1966). Most of the Green River Formation has minimal permeability, but small springs are likely to occur where sandstones outcrop (Lowham et al. 1982). Wells drilled into the Tipton Tongue can be expected to have very low yields (Welder and McGreevy 1966). The Cathedral Bluffs Tongue of the Wasatch Formation consists of claystones and shales interbedded with fine-grained sandstones. Very low yields of mineralized groundwater can be expected from wells in the Cathedral Bluffs Tongue (Welder and McGreevy 1966). Sandstones in the main body of the Wasatch Formation generally contain groundwater under artesian conditions (Welder 1968). The main body of the Wasatch Formation has moderate to large permeability and is a major shallow aquifer for the area surrounding the Rock Springs Uplift (Lowham et al. 1982). The Fort Union Formation 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 contains some zones of high permeability and is a good source of groundwater in the

general area. However, the sand layers are not large in extent and are discontinuous over the region (BBCC 1998).

The Mesaverde Formation is also a major aquifer within the Washakie Basin, although due to water quality variability and excessive drilling depths, it is considered a groundwater source near outcrop areas only. Likewise, all of the water-bearing units below the Mesaverde Group are considered important sources of groundwater only in the vicinity of their outcrops. The majority of groundwater

Table 3-11. Hydrostratigraphy of Southwest and South Central Wyoming, Including the Great Divide and Washakie Basins.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (feet)	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 the city of 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 (feet)	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 (feet)	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 (feet)	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)

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 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).

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 Pacific Rim Shallow Gas Project is proposing varying drilling depths between approximately 1,500 feet and 5,500 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 15 to 25 miles north of the project area, is actively mining coal seams of the Fort Union, Lance, and Almond Formations. The Hydrology section of Black Butte mine's WDEQ mining permit describes these coal seams as the most regionally-extensive, water-bearing strata in the general area of the mine. Other saturated zones (i.e., sandstone lenses) of these formations are often discontinuous and occur as perched systems at the Black Butte mine site. Through drilling programs and monitor well installations in and around the Black Butte mine, it is observed that the Wasatch Formation is generally dry. Water in quantities sufficient for industrial supply is found in the Ericson Formation (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 gallons per minute (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 gallons per day per foot (gpd/ft) and 30 gpd/ft, respectively. The Fort Union Formation sandstones exhibit high transmissivity values, averaging about 8,835 gpd/ft. These sandstones are generally soft, fine grained, and saturated, especially when located close to the Bitter Creek valley (BBCC 1998).

A recent (December 2003) SEO records review revealed that there are currently 14 active groundwater permits within the project area. Nine of these wells are permitted for coalbed methane (CBM) production, three are permitted for domestic and livestock water supply, and two of them are permitted to be used as temporary water supply for oil and gas well drilling.

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 1968). The 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 concentrations 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 the Tertiary aquifer system generally has 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 very high TDS concentrations (Welder and McGreevy 1966).

The TDS concentration of groundwater from the Mesaverde Group varies from less than 500 to over 50,000 mg/L (Collentine et al. 1981). The rate of increase in TDS concentration 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 et al. 1981). Major ionic composition of Mesaverde aquifer water varies with salinity and location within the Washakie Basin. Water having a TDS concentration of 1,000 to 3,000 mg/L is typically 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 springs and wells located within and near the project area. The search revealed the chemical analyses of miscellaneous grab samples collected from seven flowing springs located near the project area: four springs that issue from the Cathedral Bluffs Tongue of the Wasatch Formation, which are all located in the headwaters area of North Fork Vermillion Creek; and three springs that issue from the Tipton Tongue of the Green River Formation, which are located on Alkali Creek and lower North Fork Vermillion Creek. The search also revealed the chemical analyses of grab samples collected from six wells: two completed in the Green River Formation; one completed in the Wasatch/Fort Union Formation; and three completed in the Almond Formation.

The samples of springs flowing from the Cathedral Bluffs Tongue of the Wasatch Formation had the lowest TDS concentrations (between 225 and 329 mg/L). This formation outcrops at the higher elevations of the North Fork Vermillion Creek watershed, which is a favorable position to receive direct recharge from rain and snowmelt. Therefore, the water would have been in contact only with this formation for a relatively short time, therefore resulting in a low degree of mineralization. Calcium and sodium were the dominant cations, while bicarbonate was the dominant anion.

The three springs discharging water from the Tipton Tongue of the Green River Formation had TDS concentrations that ranged from 714 to 2,590 mg/L. Sodium was the dominant cation and bicarbonate and sulfate were the dominant anions. Alkali Spring, located on the headwaters of Salt Wells Creek about 13 miles west of the project area, discharges water from the Tipton Tongue of the Green River Formation. A sample from that spring had a TDS concentration of 760 mg/L and the water type was magnesium/sodium bicarbonate.

The two wells completed in the Green River Formation were each sampled once and the samples had TDS concentrations of 528 and 1,270 mg/L, respectively. The water type from both wells was sodium bicarbonate.

One sample was collected from a Wasatch/Fort Union well located within the project area. This well is 145 feet deep and screened in the basal part of the Wasatch Formation and, possibly, the uppermost part of the Fort Union Formation. The TDS concentration of the sample from this well was 2,400 mg/L, and the predominant ions were calcium and bicarbonate.

One sample was collected from one of the Almond wells. This well is 60 feet deep and drilled through the alluvium of East Salt Wells Creek, so the water may be a combination of that from the alluvium and the Almond Formation. The water type was a sodium sulfate with a TDS concentration of 711 mg/L. The other two Almond wells are scientific monitoring wells located within the Black Butte mine permit area and the WRDS database contained analyses of baseline samples collected from them. Seventeen samples were collected from one of these Almond monitoring wells from 1975 through 1979, and the water type was consistently sodium bicarbonate with an average TDS concentration of 2,040 mg/L. The other Almond monitoring well was sampled 11 times from 1976 through 1979 and the water type was calcium sulfate with an average TDS concentration of 3,740 mg/L.

The Black Butte mine permit (1998) describes the chemical characteristics of groundwater from the Fort Union and Almond Formations' coal seams in the general area of the mine. Because the Pacific Rim Shallow Gas Project is proposing drilling to depths between approximately 1,500 and 5,500 feet, and the coal seams of the Fort Union and Almond Formations occur at those depths in the project area, the chemical characteristics of these coal seams as identified by the Black Butte Coal Mine should be similar to that encountered at the Black Butte Mine. The predominant ionic constituents of groundwaters within coal seams of both formations are sodium and bicarbonate. Groundwater from Fort Union Formation coal seams has sodium concentrations ranging from 441 to 1,267 mg/L, with a mean of 860 mg/L. The Sodium Adsorption Ratio (SAR) values range from 16.5 to 39, with a mean of 36, and the TDS concentrations range from 1,230 to 3,497 mg/L. Groundwater from wells completed in coal seams of the Almond Formation typically has a TDS concentration in excess of 2,000 mg/L.

A low rate of recharge and slow movement of water in these coal seam aquifers are often 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/INVASIVE WEEDS

3.5.1 General Vegetation

Vegetation on the proposed Pacific Rim Project Area is dominated primarily by Wyoming big sagebrush/mixed grass prairie, Utah juniper woodland, and desert shrub communities. The project area is located within the Natural Resources Conservation Service (NRCS) Green River and Great Divide Basin (7" - 9") precipitation zone, Region 4 (USDA-NRCS 1986). As a result, native plants in this area of southwest Wyoming are predominantly drought-tolerant low shrub, grass, and flowering

forb species. Prolonged drought in southwestern Wyoming has negatively impacted many native shrub communities and several small-scale natural die-backs can be observed throughout the project area with the most conspicuous occurring in basin big sagebrush (*Artemesia tridentada* ssp. *tridentada*)/black greasewood (*Sarcobatus vermiculatus*) communities associated with intermittent and ephemeral drainages common throughout the area.

3.5.2 Vegetation Cover Types

A vegetation cover-type map of the PRPA (Figure 3-9) was provided by the Wyoming Natural Resources Clearinghouse and used to delineate primary and secondary land cover type boundaries. Information for plant species of concern on or near the project area was provided by the Wyoming Natural Diversity Database (WYNDD 2003).

The vegetation cover-type layer was derived from Landsat Thematic Mapper (TM) satellite imagery, "acquired from mid-June to late August between the years 1984 and 1993" (Merrill et al. 1996). Resolution of this layer is 100 hectares (248 acres or 0.4 section) for uplands and 40 hectares (100 acres or 0.2 section) for riparian and wetland areas. Given the resolution of the GAP layer, small stands of some cover-types do not appear on the map. For example, linear stands of basin big sagebrush commonly associated with narrow ephemeral drainages, small saltbush-dominated openings, and smaller cushion plant communities are often too small to appear at this scale of resolution.

A preliminary assessment of the general vegetation types present on the PRPA was conducted 8 September 2003 followed by a thorough vegetation mapping activity during 7-11 October 2003. This mapping project was augmented with the GAP data to delineate other smaller primary vegetation types that occur on the PRPA.

Based upon these data, Wyoming big sagebrush (*Artemesia tridentada* spp. *wyomingensis*) and desert shrubs, principally Gardner's saltbush (*Atriplex gardneri),* collectively comprise about 81.8 percent of the primary cover types on the project area. Table 3-12 shows the extent of the primary vegetation cover types on the PRPA.

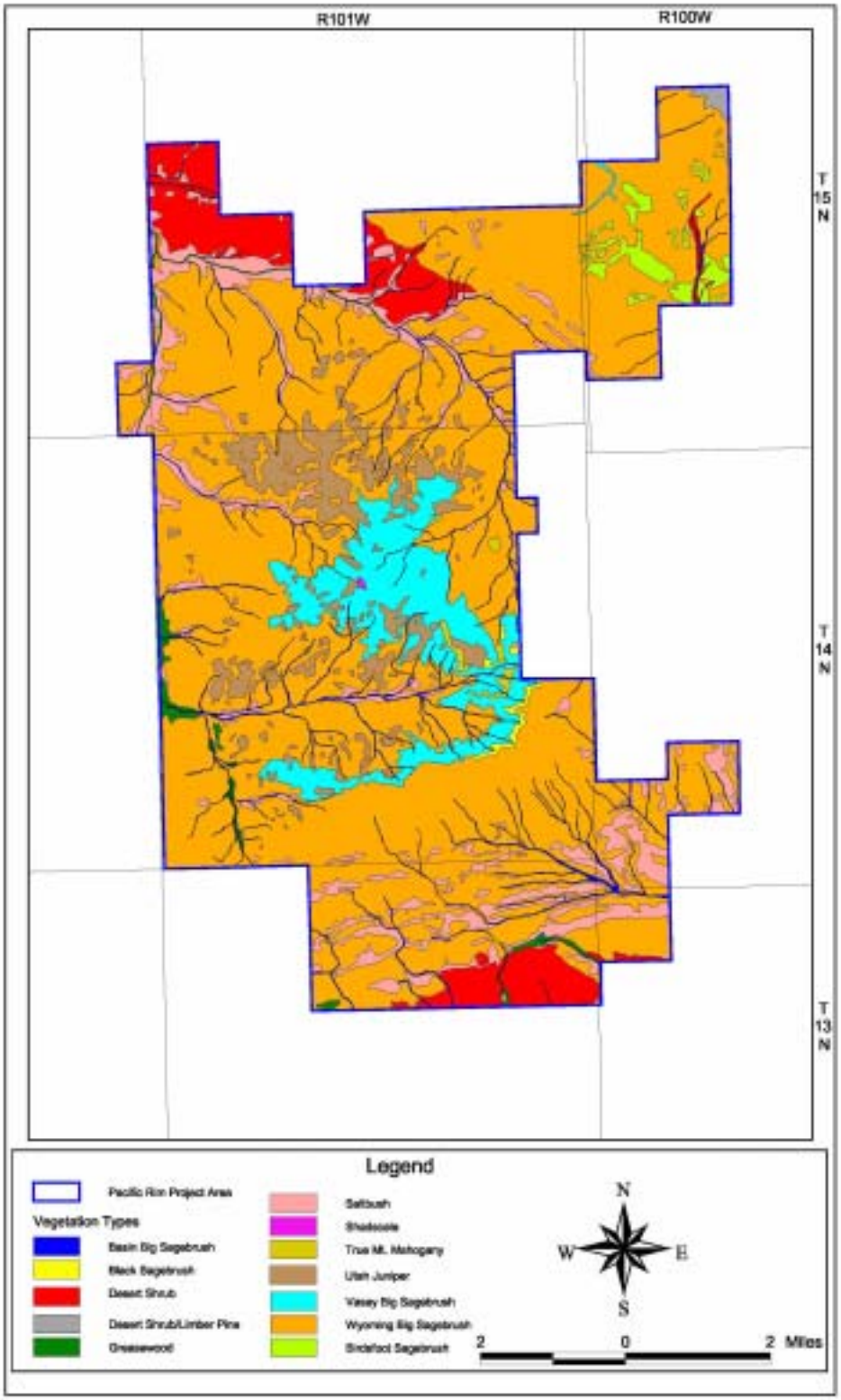
3.5.2.1 Wyoming Big Sagebrush

Wyoming big sagebrush is the most widespread cover type in the project area, covering 28,633.24 acres (66.34%). Merrill et al. (1996) describes this cover type as follows:

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.

In addition to Wyoming big sagebrush, the October mapping project revealed other *Artemesia* taxa on the PRPA, including mountain big sagebrush (*Artemesia tridendata* ssp. *vaseyana* var. *pauciflora*), Vasey big sagebrush (*A. tridendata* ssp*. vaseyana* var. *vaseyana*), black sagebrush *(A.*

nova), basin big sagebrush, birdsfoot sagebrush (*A. pedifida*), plains silver sagebrush (*A. cana* ssp. *cana,* mountain silver sagebrush (*A. cana* ssp. *visdiscula*), and alkali sagebrush (*A. longiloba*). A variation of Wyoming big sagebrush (*gosiute*) was located and identified in the southern portion of the PRPA. This undescribed variation of Wyoming big sagebrush is believed to occur in soils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Legend
Pacific Rim Project Area
Vegetation Types
Basin Big Sagebrush
Black Sagebrush
Desert Shrub
Desert Shrub/Limber Pine
Greasewood
Saltbush
Shadscale
True Mt. Mahogany
Utah Juniper
Vasey Big Sagebrush
Wyoming Big Sagebrush
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Figure 3-9. Primary Vegetation Cover Types on the PRPA.

associated with shoreline deposits of the paleolake Gosiute which covered most of the project area during the Eocene (Winward 1999). The total acreage of these other *Artemesia* species and sub-species is shown in Table 3-12.

3.5.2.2 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, greasewood and/or desert cushion plants (Merrill et al. 1996). Many saltbush dominated communities occur on the PRPA and these sites are characterized by an accumulation of salt in poorly developed soils with a pH of 7.8 to 9.0. Grass cover is negligible and bare ground usually exceeds 50%. Birdsfoot sagebrush also occurs in alkaline soils with pH levels of 8.5 to 11. At the lower pH levels, birdsfoot sagebrush can occur with Gardner's saltbush in varying densities. At the higher pH levels, birdsfoot sagebrush usually occurs as a monoculture.

Total land area of the PRPA occupied by desert shrub-type communities is about 7,104 acres, which represents about 16.5% of the project area.

Table 3-12. Primary vegetation cover types on the Pacific Rim Project Area identified by field.

Vegetation Cover Type	Primary	
	Acres	**Percent**
Wyoming big sagebrush	28633.24	66.34
Saltbush fans and flats	3900.03	9.04
Vasey big sagebrush	3013.12	6.98
Desert shrub	2751.94	6.38
Utah juniper	2323.32	5.38
Basin big sagebrush	1251.05	2.90
Birdsfoot sagebrush	535.56	1.24
Greasewood flats and fans	361.50	0.84
True mountain mahogany	164.81	0.38
Black sagebrush	125.92	0.29
Desert shrub/Limber pine	90.59	0.21
Shadscale	8.52	0.02
Total	**43159.6**	**100.0**

3.5.2.3 Mixed Grass Prairie

Intermixed with the primary vegetation cover types on the PRPA are scattered areas mixed grass prairies. 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 (*Krascheninnikovia 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).

3.5.3 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 0.04-0.16 inches 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. 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 (Belnap et al. 2001).

3.5.4 Noxious and Invasive 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 species have been documented as invasive (Hartman and Nelson 2000). Of these 428 plants, 24 are designated as noxious by the State of Wyoming (Rice 2002) and are shown in Table 3-13.

Table 3-13 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
Hypericum perforatum	Common St. Johnswort
Tanacetum vulgara	Common tansy

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

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 favor the establishment of noxious weeds in stressed or disturbed habitats.

The most common invasive plant species observed on the PRPA are halogeton (*Halogeton glomeratus*), small infestations of downy brome (*Bromus tectorum*), Russian thistle (*Salsosa iberica*) gray horsebrush (*Tetradymia canescens*), and broom snakeweed (*Gutierrezia sarothrae*). Infestations are mostly associated with disturbed surfaces along road and pipeline rights-of-way (ROW). An unusually heavy infestation of halogeton was observed throughout central and western Wyoming during the 2003 growing season. Greatest densities were observed on disturbed areas such as road and pipeline ROW's, livestock feeding areas, and corrals; however, this poisonous plant was also observed invading un-disturbed rangeland.

3.5.5 Waters of the United States, Including Wetlands

The U.S. Fish and Wildlife Service (FWS) mapped wetlands according to the classification system of Cowardin et al. (1979) to create the National Wetlands Inventory (NWI). Digital files covering the area of the PRPA (nwi3) were downloaded by WYNDD (2003) from the web site of the University of Wyoming's Geographic Information Science Center (WGISC). Relevant portions were clipped from the map to provide wetland data for the project area using ArcView7 GIS software.

Waters of the US. All drainages (streams, draws, washes) in the PRPA are within the WDEQ fifth order hydrologic unit WYGR14040105 that eventually drain into the Green River. No perennial streams are located on the project area (J. Henderson 2004). Most of the surface water features in the project area qualify as Waters of the United States. Channels that carry surface flows and that show signs of active water movement are classified as 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)] and are regulated by the Army Corps of Engineers (COE). Many ephemeral drainage channels identified on the USGS topographic maps for the PRPA are vegetated swales and are not considered to be Waters of the U.S. (COE 1987, 1992).

Any activity that involves discharge of dredge or fill material into or excavation of "Waters of the U.S." 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 Department of Environmental Quality (WDEQ).

Wetlands. 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 (COE 1987, 1992).

Wetlands cover about 1.25 million acres (2 percent) of Wyoming and are the most diverse ecosystems in the State's semi-arid environment (Yuhas 1996). The physical, chemical, and biological interactions within wetlands are often referred to as wetland functions. These functions include surface and subsurface water storage, nutrient cycling, particulate removal, maintenance of plant and animal communities, water filtration or purification, and ground water recharge. The NWI has mapped wetlands throughout the project area and these are shown in Figure 3-10.

The most common linear wetland as shown in Figure 3-10 is classified as R4SBA (Riverine-Intermittent-Streambed-Temporarily Flooded). The total length of these intermittent streams within the project area is about 20,536 m (or about 12.8 miles). Many individual wetlands are so small that they hardly appear on a small-scale map such as Figure 3-10 (WNYDD 2003). Palustrine, Unconsolidated Shore Class wetlands (characterized by poorly vegetated bars) also account for a substantial number of small wetlands. All these wetland types are described in Cowardin et al. (1979). Table 3-14 describes the wetland types and their extent for the project area.

Table 3-14. Wetland types and extent on the Pacific Rim Project Area[1].

Type	Area (ac.)	Length (m/ft)
PEMC	----	1153.9/3585.9
R4SBA	----	20536.1/67378.9
PABFh	0.9	----
PUSA	5.7	----
PUSAh	1.6	----
PUSCh	6.2	----

[1] Source: WYNDD

3.6 RANGELAND RESOURCES

The proposed PRPA lies within the Rock Springs Grazing Allotment (No. 13018) and the Vermillion Creek Grazing Allotment (No. 04003). The northern portion of the project area lies within the Rock Springs Allotment and is composed of checkerboard lands owned or leased by the Rock Springs Grazing Association. The southern portion of the PRPA lies within the Vermillion Creek Allotment. Cattle and sheep are the primary livestock types permitted for the two allotments. Table 3-15 describes the affected allotments. Stocking rates for the two allotments are about 10 acres per animal unit month (AUM) for the Rock Springs Allotment and 11 acres/AUM for the Vermillion Creek Allotment.

Table 3-15. Grazing allotments and permitted AUM's within the Pacific Rim Project Area.[1]

Allotment Name	Allotment #	Total Acres	Total AUM's	Permittees
Rock Springs	13018	1,797,178	180,237	22
Vermillion Creek	04003	149,143	13,543	4

[1] Source: Kevin Lloyd, Range Management spec., RSFO (2004)

3.7 WILDLIFE AND FISHERIES

3.7.1 Wildlife

3.7.1.1 Introduction

The PRPA lies within the BLM Rock Springs Field Office. Objectives for wildlife management in the Rock Springs Field Office are directed by the ROD of 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 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 an approximate six-mile zone surrounding it. Since activities
within the project 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) (WGFD 2003a). 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. Data was also 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 (WYNDD 2003). Although wild horses are not managed as wildlife by the WGFD and BLM, they are included in the wildlife sections of this document.

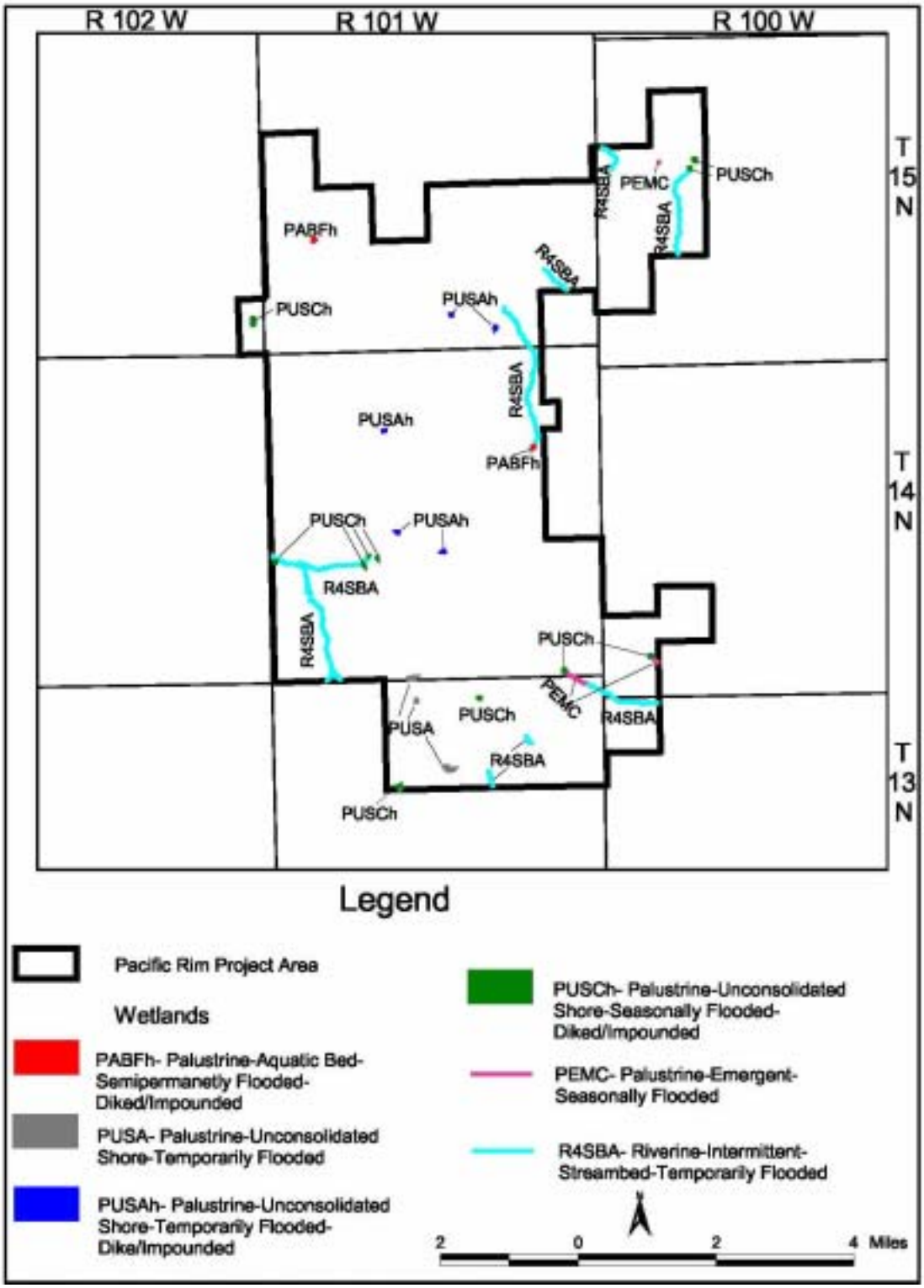


Figure 3-10. Wetlands on the PRPA.

Existing wildlife information for the project area was supplemented through survey data collected by Hayden-Wing Associates (HWA) biologists during the fall of 2003. The data collections in the fall of 2003 consisted of aerial and ground surveys to determine: (1) the occurrence, location, and size of white-tailed prairie dog colonies; (2) the occurrence, location, and size of potential mountain plover habitat; and (3) the presence/absence of black footed ferrets within white-tailed prairie dog colonies that provide suitable habitat.

3.7.1.2 Wildlife Habitat

Wildlife habitats that could be affected by the project include areas that would be physically disturbed by the construction of gas wells, related roads, pipelines, and production facilities, as well as zones of influence. 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.

The two most extensive wildlife habitats within the PRPA are Wyoming big sagebrush steppe and juniper/sagebrush woodlands. Smaller areas of desert shrub, mixed grass prairie, and intermittent shrub-dominated riparian habitats also occur on the project area. See Section 3.5.2 for further description of vegetation types within the PRPA.

3.7.1.3 General Wildlife

A total of 310 species has been recorded on or proximal to the project area either as residents or migrants and includes 59 mammal species, 242 bird species, 4 amphibian species, and 5 reptile species (Appendix A). The presence of these wildlife species was determined from the sources of information discussed in Section 3.7.1. Although all species in Appendix A are important members of a functioning ecosystem and wildlife community, most are common and have wide distributions in the region.

3.7.1.4 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.

According to the Green River RMP, big game crucial winter ranges and parturition areas will be protected to ensure continued usability by limiting activities during critical seasons of use and by limiting the amount of habitat disturbed. Crucial big game winter range is defined as those areas that are available, relatively intact, and winter most of the population at its objective in adequate body condition, eight or more years out of ten (ROD Green River RMP, Appendix 7).

Mule Deer. The project area lies within the South Rock Springs Herd Unit. The entire project area is utilized by mule deer on a year-round basis. Nearly 7,648 acres (17.7%) of the project area is crucial winter/yearlong mule deer range, located in the southwestern and extreme northeastern portions of the project area (Figure 3-12). This constitutes 2.2% of the crucial winter range in the South Rock Springs Herd Unit. No designated mule deer parturition areas occur in the PRPA.

Elk. The project area lies primarily within the Petition Herd Unit, but a small portion is located in the

South Rock Springs Herd Unit (Figure 3-13). The Petition Herd Unit consists of isolated groups of

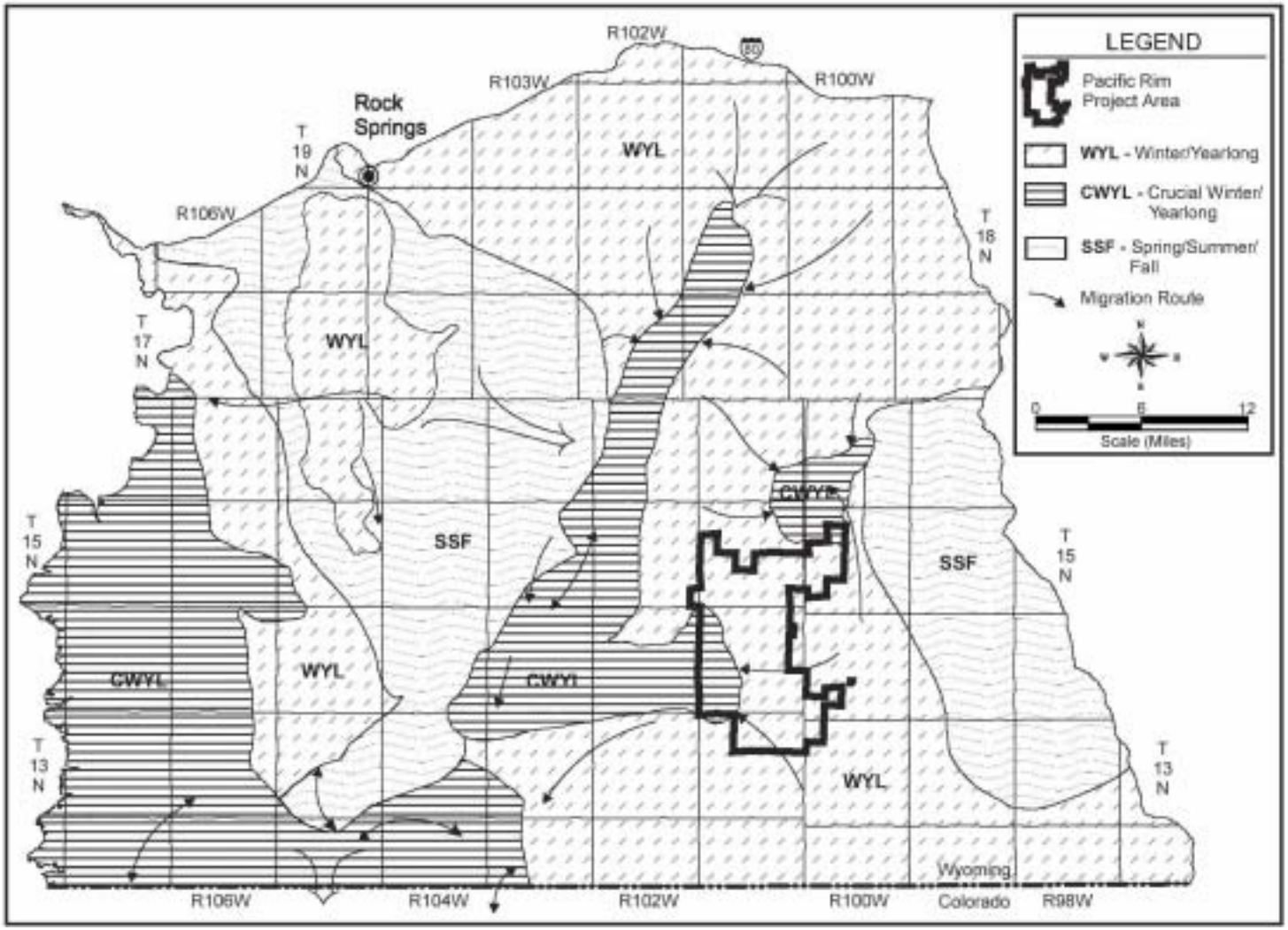


Figure 3-11. South Rock Springs Mule Deer Herd Unit seasonal ranges in relation to the PRPA.

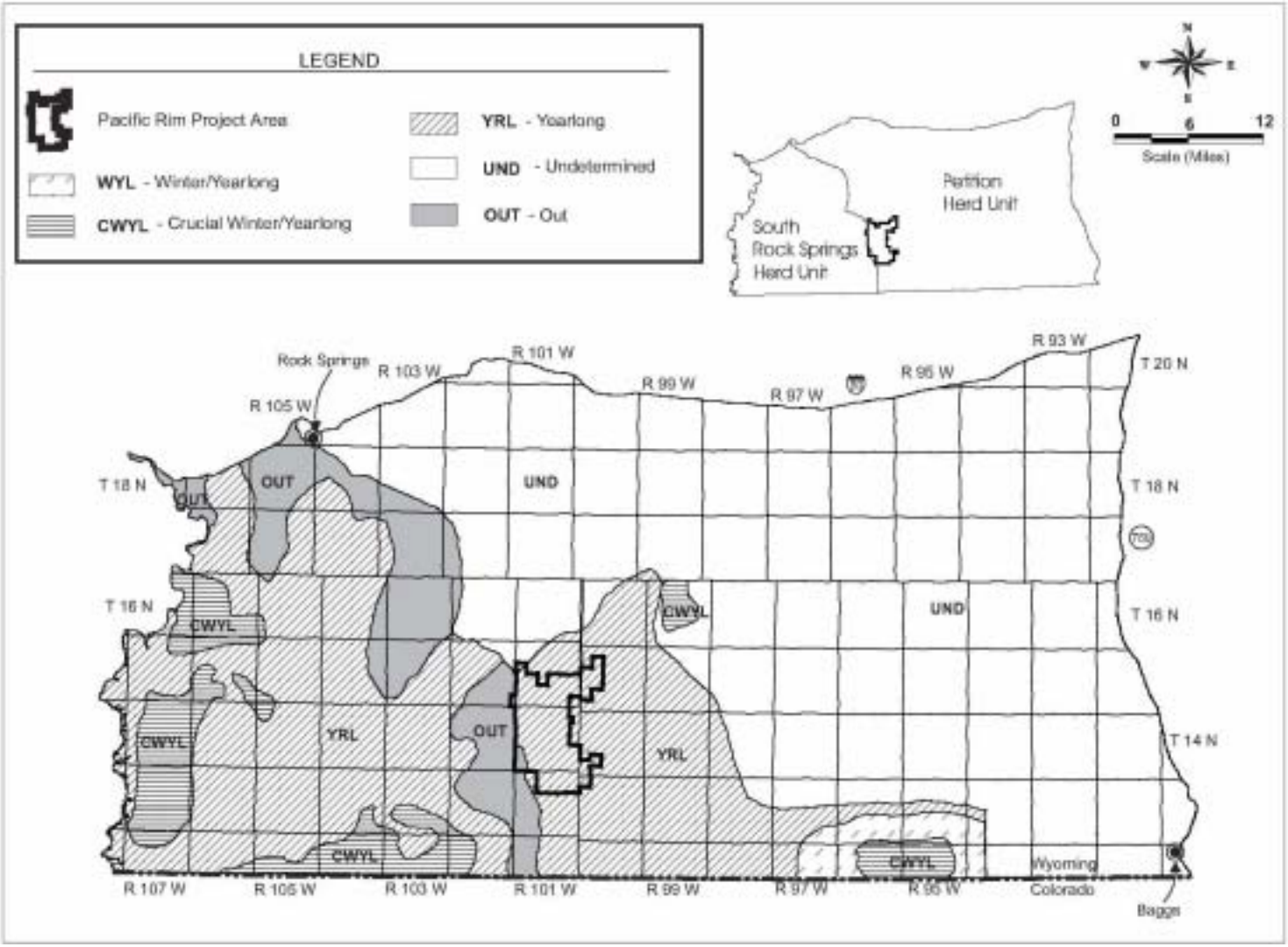


Figure 3-12. Petition and South Rock Springs Elk Herd Unit seasonal ranges in relation to the PRPA.

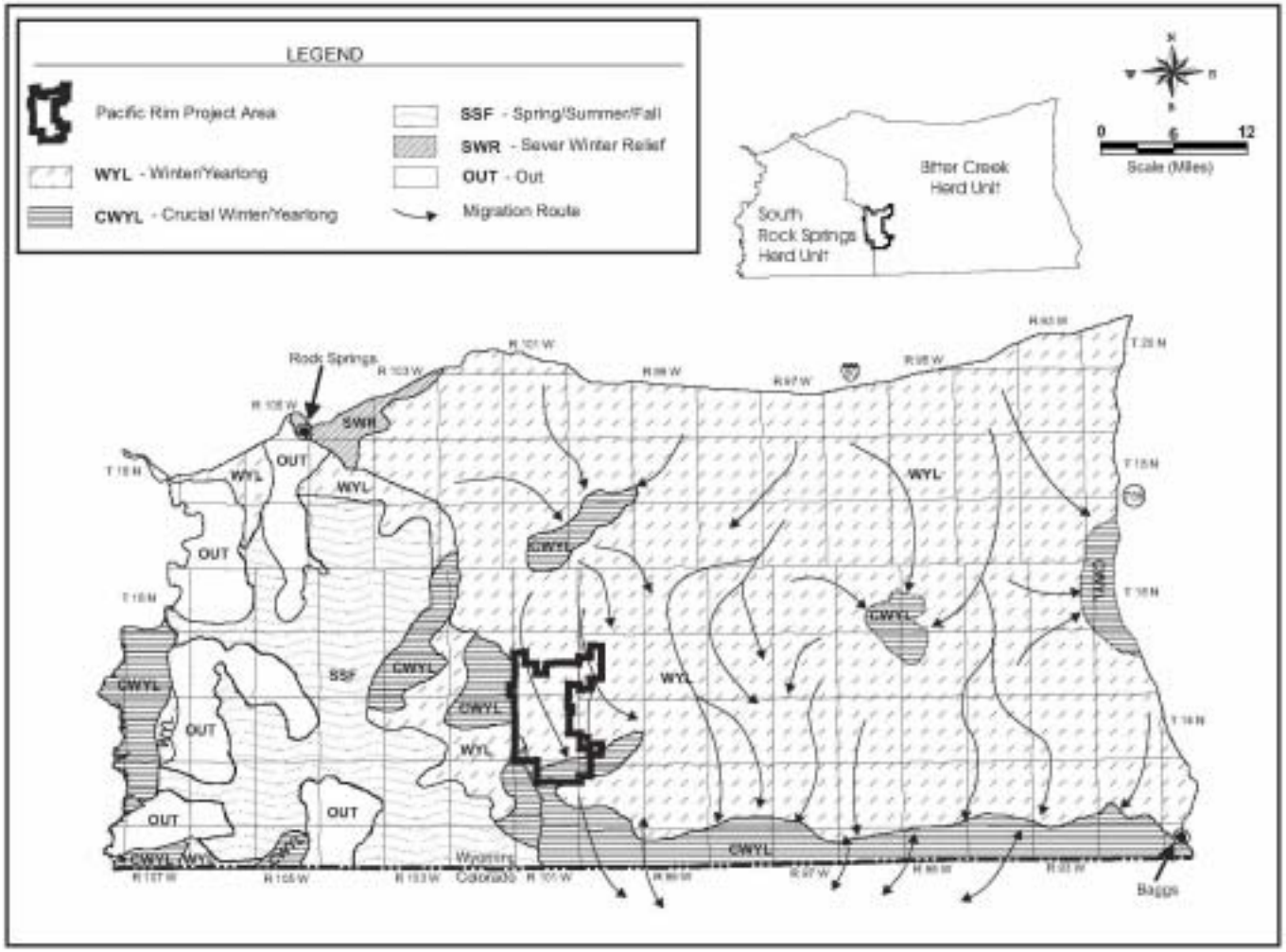


Figure 3-13. South Rock Springs and Bitter Creek Pronghorn Herd Unit seasonal ranges in relation to the PRPA

Figure 3-14. Big Game Crucial Seasonal Ranges in relation to the PRPA.

elk that utilize 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 project area includes no designated elk crucial winter range or parturition areas.

Pronghorn Antelope. The project area lies primarily within the Bitter Creek Herd Unit, but a small portion is in the South Rock Springs Herd Unit. The entire project area is utilized by pronghorn on a year-round basis. Approximately 15.5% or 6,705 acres of the project area is classified as crucial winter/yearlong pronghorn habitat (Figure 3-14). Crucial winter/yearlong pronghorn range is found in the southern portion and along the western edge of the project area (Figure 3-14). No designated pronghorn parturition areas occur in the PRPA.

Big Game Summary. The southern portion of the project area provides crucial habitat for pronghorn, while the southwestern and extreme northeastern portions of the project area provide crucial habitat for mule deer. A small area in the southwestern portion of the project area (662 acres) includes both mule deer and pronghorn crucial winter/yearlong range (Figure 3-14). The majority of the project area is used by elk on a year-round basis, however, none of the habitat is considered to be elk crucial winter range.

3.7.1.5 Wild Horses

A wild horse is defined as an unbranded and unclaimed free roaming horse in the western United States. Wild horses are protected and managed in accordance with the Wild Horse and Burro Act of 1971 (Public Law 92-195). They are classified to genus and species as *Equis caballus* and can be either domesticated or feral (feral refers to a wild state of existence for domesticated animals). The passage of the Wild Free Roaming Horse and Burro Act of 1971 officially assigned the status of wild horse to feral horses.

The PRPA lies within the Salt Wells Wild Horse Herd Management Area (HMA), which encompasses about 1,193,283 acres, of which 725,704 acres are BLM-administered public lands (61%). The remaining lands (39%) are predominantly checkerboard lands leased/owned by the Rock Springs Grazing Association (RSGA). Boundaries of the HMA extend from U.S. Highway 191 south of Rock Springs east to the Rock Springs-Rawlins Field Office management area boundary and south to the Wyoming-Colorado state line (USDI-BLM 1999a). The total surface area of the proposed PRPA represents about 3.6% of the total land surface area of the HMA.

The BLM Bureau 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 current wild horse population estimate for the Salt Wells HMA is 345 horses. This population level falls within the desired range of 251-365 animals established for this HMA. A wild horse population census update of the Salt Wells HMA is scheduled for 1 March 2004 (Lloyd 2004).

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 1999a). The primary human-made hazards to wild horses in the PRPA may be possible injuries due to vehicle traffic and barbed wire fences. Minimal fencing exists in the HMA and is mostly associated with deeded property or major highways (i.e., WYO 430). Most secondary roads, grazing allotments, as well as checkerboard lands, are not fenced in the Salt Creek HMA (USDI-BLM 1999a).

3.7.1.6 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.

Greater Sage-grouse. See section 3.8.2.2.

Mourning Dove. Mourning doves may be found on the project area during the spring and summer months and are typically associated with sagebrush-grass, mountain shrub, and riparian habitats. It is likely that some mourning doves utilize the PRPA during the breeding season.

3.7.1.7 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 3.5.5). However, the limited wetlands available may still provide adequate cover and nesting habitat for a very limited number of waterfowl during moist years.

3.7.1.8 Raptors

According to the WOS data (WGFD 2003a), 13 raptor species have been observed on or within six miles of the PRPA: American kestrel (*Falco sparverius*), burrowing owl (*Athene cunicularia*), Cooper's hawk (*Accipiter cooperii*), ferruginous hawk (*Buteo regalis*), bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), great horned owl (*Bubo virginianus*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), short-eared owl (*Asio flammeus*), and Swainson's hawk (*Buteo swainsoni*). Records from the BLM Rock Springs Field Office and HWA show that 23 raptor nests occur on or within one mile of the PRPA (Figure 3-15). Two of the raptor nests (identified by HWA) were red-tailed hawk nests; the species utilizing the remainder of the nests was unknown. Current activity status for the known raptor nest sites is unknown. Activity status of raptor nests will be checked at the APD level prior to well development. A one-mile buffer was placed around the 23 raptor nests and this area covers approximately 12,524 acres (29%) of the PRPA. This is the estimated area that may be subject to raptor stipulations from February 1 to July 31.

3.7.2 Fish

3.7.2.1 Fish Introduction

The PRPA lies within the Green River Basin. Most of the PRPA drains in a westerly direction into East Salt Wells Creek (Figure 3-7 Surface Water Features in the Pacific Rim Project Area). East Salt Wells Creek flows from the PRPA northwesterly into Salt Wells Creek, which is a tributary of Bitter Creek. Bitter Creek flows into the Green River at Green River, WY. Some of the northeastern, eastern and southeastern portions of the PRPA drain into Alkali Creek, a tributary of Vermillion Creek. A small part of the southwest portion of the PRPA drains into the North Fork of Vermillion Creek and hence into Vermillion Creek. Vermillion Creek flows south into Colorado and, hence, into the Green River.

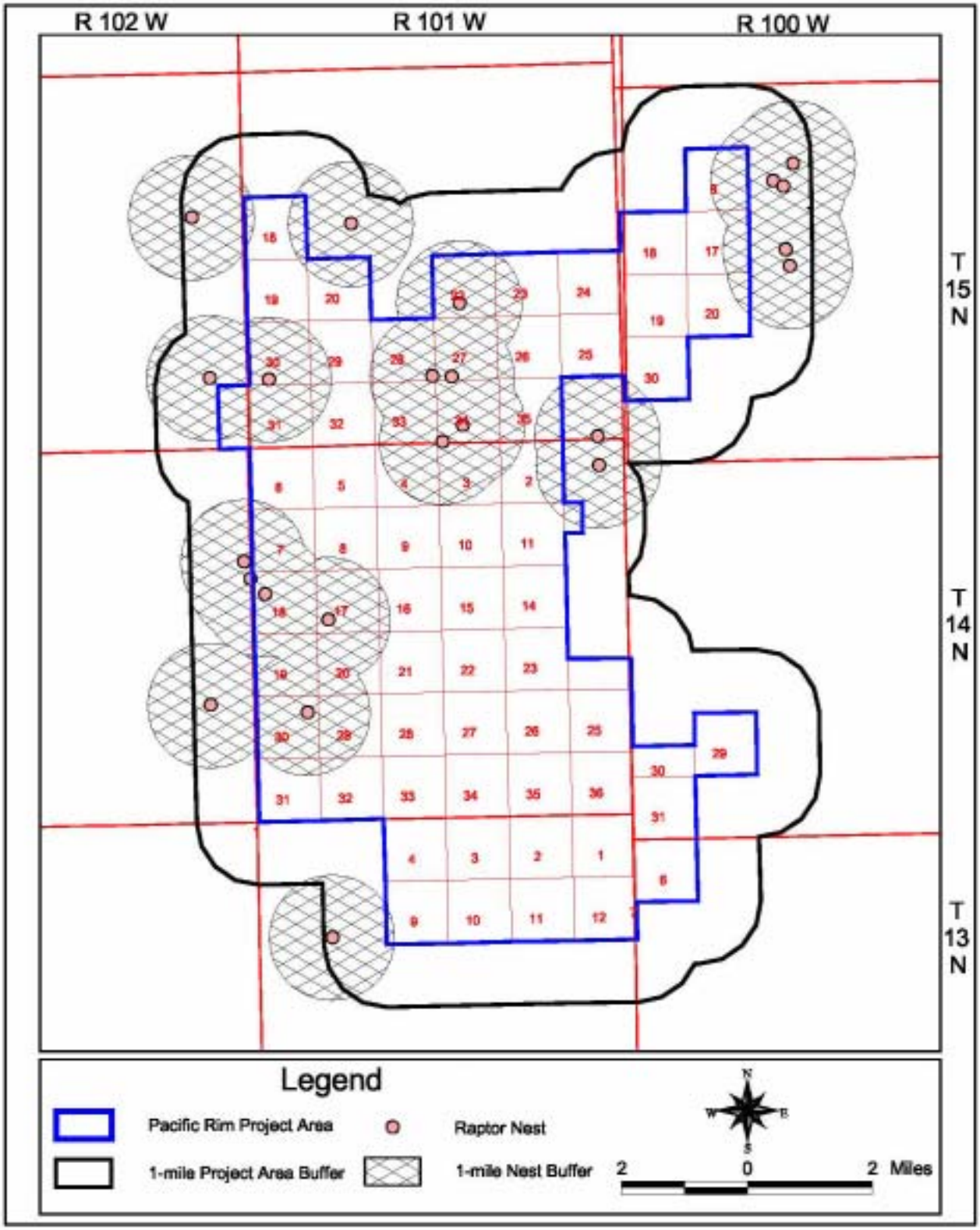


Figure 3-15. Raptor nests in relation to the Pacific Rim Project Area.

3.7.2.2 Fish Habitat

No perennial streams are present within the PRPA. All of the streams are ephemeral or intermittent. The PRPA also has a number of small ephemeral impoundments that are primarily used as water sources for livestock and wildlife, but which do not support fisheries. All streams within the PRPA are classified by the WGFD (1991) as Class 5 ephemeral drainages without fishery resources. The first streams downstream of the project are East Salt Wells Creek, Alkali Creek, Black Butte Creek, North Fork Vermillion Creek and Vermillion Creek. All except North Fork Vermillion Creek and Vermillion Creek are intermittent or ephemeral waters that do not support fish. Salt Wells Creek and Bitter Creek are intermittent Class 5 waters that only have non-game fish species. The North Fork Vermillion Creek upstream of the PRPA supports one game species, brook trout (*Salvelinus fontinalis)* and is a Class 3 water of regional importance. Most of the non-game species in these streams are native species. The Green River in Wyoming and Colorado supports a wide variety of game and non-game fish species, both native and non-native. In Wyoming, the Green River downstream of Bitter Creek is a Class 2 water that supports a fishery of state-wide importance.

No water quality data are available for any streams within the PRPA. Salt Wells Creek, Bitter Creek, and Vermillion Creek are desert streams characterized by low base flows and high concentrations of dissolved solids (Section 3.4.2.2). During periods of high flow, such as following rainstorms or snow melt, these waters often have very high concentrations of suspended solids.

3.7.2.3 General Fish

Twenty-six fish species are potentially present in waters downstream of the PRPA in Salt Wells Creek, Bitter Creek, North Fork Vermillion Creek, Vermillion Creek and the Green River (Appendix B-2). No game fish species are present in the three perennial and intermittent creeks immediately downstream of the PRPA, while at least 10 game fish species are present in the Green River downstream of Bitter Creek. Among the non-game species, four are endangered (Section 3.8.1.2) and four are BLM sensitive species (Section 3.8.2.2), though one is outside of its historic range.

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, Candidate, or Proposed for Listing Species of Wildlife, Fish, and Plants

The FWS has determined that one mammal, two birds, four fish, and one plant species listed as either threatened, endangered, candidate or proposed under the ESA may potentially be found or be affected by activities conducted within the project area (USDI-FWS 2003). These species and their federal status under the ESA are listed in Table 3-16. The black-footed ferret, bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker are listed as endangered. The bald eagle and Ute ladies'-tresses are listed as threatened and the yellow-billed cuckoo is a candidate for listing as endangered under the ESA. The four endangered fish species, which are downstream residents of the Colorado River System, are included in this analysis because of potential water

depletions to the Colorado River System.

Table 3-16. Threatened, endangered, proposed, and candidate species potentially affected by or present on the Pacific Rim Project Area.

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 chub	*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 2003

3.8.1.1 Mammal Species

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 young (Hillman and Clark 1980, Fagerstone 1987). Existing white-tailed prairie dog colonies located on the PRPA were mapped by HWA in early September, 2003. An aerial survey was conducted on September 2, 2003 to locate white-tailed prairie dog colonies. The colonies located from the air were then mapped in their entirety from the ground, on foot, or from an ATV (Biggins et al. 1989). Boundaries of the colonies were mapped using a hand-held GPS receiver. Fifty-seven white-tailed prairie dog colonies were mapped on and near the PRPA; these colonies covered a total of 4,391 acres, with 3,237 acres occurring within the PRPA boundary (Figure 3-16). Eighteen colonies, covering 3,612 acres, were surveyed for the presence of black-footed ferrets in September and October 2003 (HWA 2003a, b). All black-footed ferret surveys were performed in accordance with black-footed ferret survey guidelines outlined by the FWS (USDI-FWS 1989). No black-footed ferrets or their sign were observed in the white-tailed prairie dog colonies that were surveyed (HWA 2003a, b). No black-footed ferrets or their signs were observed during the nocturnal spotlight survey or morning ground search (HWA 2003a,b). Survey results and maps are available at the BLM RSFO.

3.8.1.2 Bird Species

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. Thirteen records of bald eagle occurrence approximately seven miles south of the project area were recorded in the WOS in January 1980 and February 1985 (WGFD 2003a). Although nesting and wintering habitat is limited, bald eagles may occasionally utilize the project area for hunting or foraging.

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 2003a, WYNDD 2003) it is unlikely that the yellow-billed cuckoo occurs on the project area.

3.8.1.3 Fish Species

Four federally endangered fish species may occur as downstream residents of the Green and Colorado River system: Colorado pikeminnow (*Ptychocheilus lucius*), bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*) (USDI-FWS 2003). The Colorado pikeminnow, bonytail chub, and humpback chub are all members of the minnow family. The razorback sucker is a member of the sucker family. All four of these fish species share similar habitat requirements and historically occupied the same river systems. Declines in populations of these species are mainly attributed to impacts of water development (e.g. dams and reservoirs) on natural temperature and flow regimes, creation of migration barriers, habitat fragmentation, the introduction of competitive and predatory non-native fishes, and the loss of inundated bottom lands and backwater areas (Minckley and Deacon 1991, USDI-FWS 1993).

The last occurrence of any of these fish species in the Green River in Wyoming was prior to the filling of Flaming Gorge Reservoir in 1963. Habitat for these species is not present within the PRPA and critical habitat for these species has not been designated in Wyoming (Upper Colorado River Endangered Fish Recovery Program 1999). However, the potential for project-related reductions in water quantity and/or quality to these tributaries to the Green River and Colorado River warrant their inclusion in this NEPA document.

Colorado Pikeminnow. The Colorado pikeminnow is the largest member of the minnow family and occurs in swift, warm waters of Colorado Basin rivers. 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. It was known to occur historically in the Green River in Wyoming at least as far north as the City of Green River.

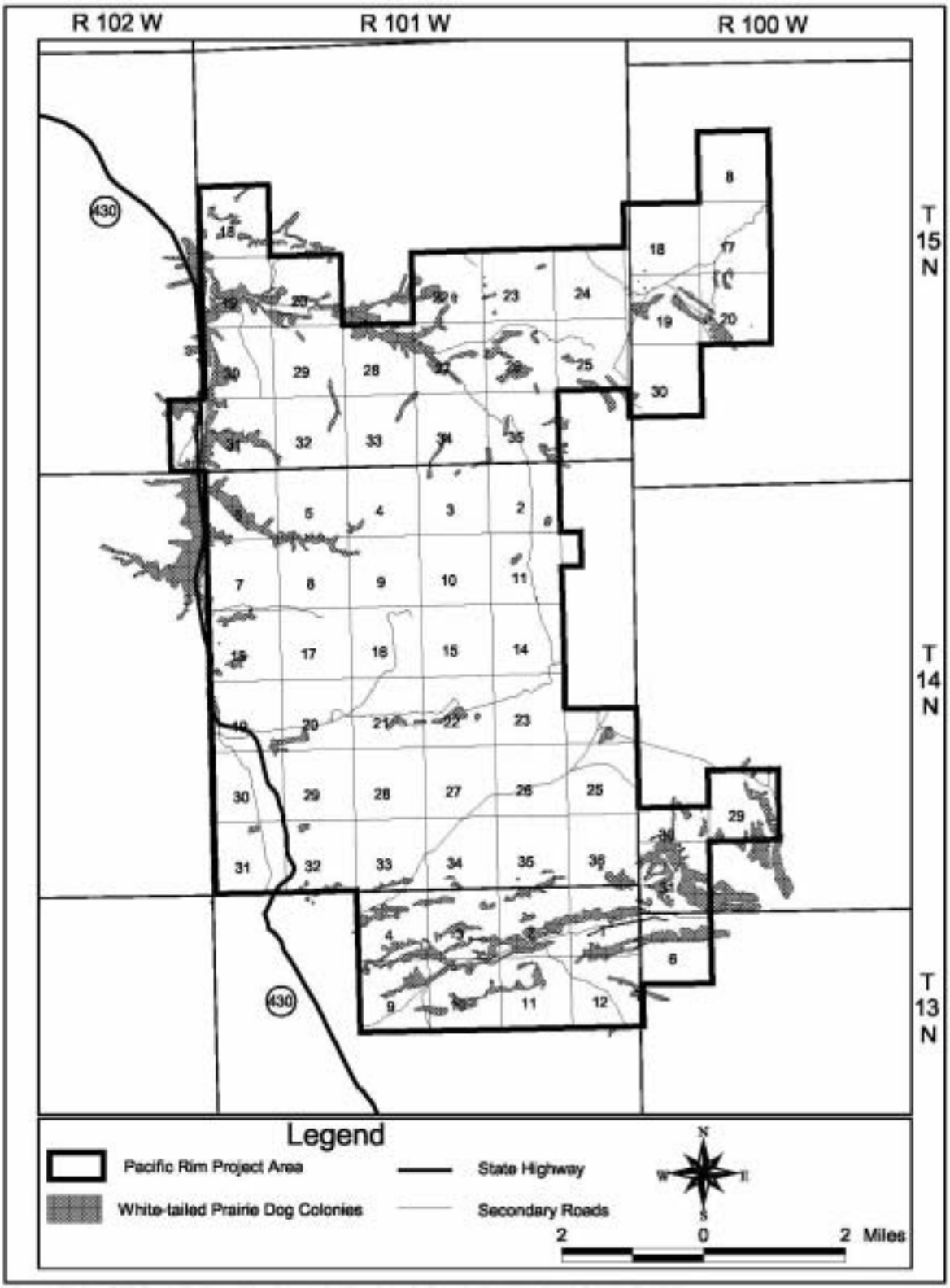


Figure 3-16. White-tailed prairie dog colonies in relation to the Pacific Rim Project Area.

Bonytail Chub. Habitat of the bonytail chub 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 1999). With no known reproducing populations in the wild today, the bonytail chub is thought to be the rarest of the endangered fishes in the Colorado River System.

The bonytail chub historically inhabited portions of the upper and lower Colorado River basins. Today, in the upper Colorado River Basin, only small, disjunct populations of bonytail chub are thought to exist in the Yampa River in Dinosaur National Monument, in the Green River at Desolation and Gray canyons, in the Colorado River at the Colorado/Utah border, and in Cataract Canyon (Upper Colorado River Endangered Fish Recovery Program 1999).

Humpback Chub. Habitat of the humpback chub is also 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 1999). The humpback chub was historically found throughout the Colorado River System, and its tributaries, which are used for spawning (Valdez et al. 2000). It is estimated that the humpback chub currently occupies 68% of its original distribution in five independent populations that are thought to be stable (Valdez et al. 2000).

Razorback Sucker. The razorback sucker is an omnivorous bottom feeder and is one of the largest fishes in the sucker family. Adult razorback sucker habitat use varies depending on season and location. This species was once widespread throughout most of the Colorado River Basin from Wyoming to Mexico. Today, in the 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 (Upper Colorado River Endangered Fish Recovery Program 1999).

3.8.1.4 Plant Species

No federally listed threatened, endangered, or candidate plant species are known to occur on the PRPA (Glennon 2004). Ute ladies'-tresses (*Spiranthes diluvialis*), a FWS threatened species, is known to occur in certain habitats along the Green River in Daggett County, Utah, south of the PRPA. Although no suitable habitat for Ute ladies'-tresses occurs on the PRPA, the proximity of known populations in Utah requires field surveys for the plant in Sweetwater County to meet FWS and ESA Section 7 requirements for Environmental Assessments (Glennon 2004). The following description of the plant and its habitat requirements is summarized from information provided by the FWS (2003) and Fertig (2000).

Ute ladies'-tresses. Ute ladies'-tresses is a perennial, terrestrial orchid with stems 12 to 50 cm tall, narrow leaves, and flowers consisting of a few to many white or ivory flowers clustered into a spike arrangement at the top of the stem. It blooms from late July through August; however, depending on location and climatic conditions, orchids may bloom in early July or still be in flower as late as early October. Plants probably do not flower every year and may remain dormant below ground during drought years.

The Ute ladies'-tresses is 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 wet meadows 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 wetness in the root zone through

the growing season. The orchid seems generally intolerant of shade and is found primarily in open grass and forb-dominated sites where vegetation is relatively open and is not dense or overgrown. The plants usually occur in small scattered groups.

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. It is BLM policy (BLM policy under 6840) to manage these species to preclude the need for listing under the ESA. Sensitive species included in this section include those listed 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 sensitive wildlife, fish, and plant species found in the Rock Springs Field Office and their sensitivity status/rank are listed in Table 3-17. The RSFO identified several of these species to be considered in more detail; a discussion of those species follows.

3.8.2.1 Mammals

Nine sensitive mammal species may potentially be found on the PRPA (USDI-BLM 2002; Table 3-17). 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 five of these species that should be considered in more detail: Townsend's big-eared bat, swift fox, Wyoming pocket gopher, pygmy rabbit, and white-tailed prairie dog.

Townsend's Big-eared Bat. This bat can be found throughout Wyoming and its distribution is likely determined by the availability of roosts such as caves, mines, tunnels, and crevices with suitable temperatures (Clark and Stromberg 1987). The Townsends big-eared bat is known to gather in small groups. They can be found roosting in mines, caves, and structures in woodlands and forests generally up to 9,500 feet elevation, but sometimes higher. The most typical habitats for this bat are desert shrub lands, pinon-juniper woodlands, or dry coniferous forests (Armstrong et al. 1994). Potential habitat for Townsend's big-eared bat does occur within the PRPA and it is possible that it may occur there.

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 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 PRPA in southern Sweetwater County.

No records of swift fox were documented in the WOS (WGFD 2003a) or WYNDD (2003) within six miles of the PRPA. Although the majority of the project area is not ideal habitat, the eastern 1/3 of the project area may provide low quality habitat for swift fox.

Table 3-17. Sensitive wildlife, fish, and plant species potentially present in the PRPA.[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	Possible
Townsend's big-eared bat	*Corynorhinus townsendii*	R2/R4, G4/S1B, S2N, NSS2	Possible
Birds			
Mountain Plover	*Charadrius montanus*	G2/S2B, SZN	Likely
Sage sparrow	*Amphispiza belli*	G5/S3B, SZN	Likely
Brewer's sparrow	*Spizella breweri*	G5/S3B, SZN	Likely
Long-billed curlew	*Numenius americanus*	G5/S3B, SZN, R2, NSS3	Unlikely
Yellow-billed cuckoo	*Coccyzus americanus*	G5/S2B, SZN, FSR2, TBNG, NSS2	Unlikely
Sage thrasher	*Oreoscoptes montanus*	G5/S3B, SZN	Likely
Western burrowing owl	*Athene cunicularia*	R2, G4/S3B, SZN, NSS4	Present
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
Common Name	**Scientific Name**	**Sensitivity Status[2]**	**Occurrence Potential[3]**
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

Plant Species

Common Name	Scientific Name	Status[2]	Habitat	Occurrence Potential[3]
Meadow pussytoes	*Antennaria arcuata*	G5/S2 RSFO	Moist, hummocky meadows, seeps or springs surrounded by sage/grasslands 4950 to 7900'	Low
Small rock cress	*Arabis pusilla*	G1/S1 RSFO	Cracks crevices in sparsely vegetated granite/pegmatite outcrops within sage/grasslands 8000 to8100'	Low
Mystery wormwood	*Artemesia biennis* var. *diffusa*	G5T1/S1 RSFO	Clay flats and playas 6500'	Low, known-private land ownership
Nelson's milkvetch	*Astragalus nelsonianus*	G2/S2 CO RSFO	Alkaline clay flats, shale bluffs and gullies, pebbly slopes and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities 5200 to 7600'	Possible
Precocius milkvetch	*Astragalus proimanthus*	G1/S1 RSFO	Cushion plant communities on rocky, clay soils mixed with shales on summits and slopes of white shale hills 6800 to 7200'	Low
Cedar Rim thistle	*Cirsium aridum*	G2Q/S2 RSFO	Barren, chalky hills, gravelly slopes and fine-textured, sandy-shaley draws 6700 to 7200'	Low
Ownbey's thistle	*Cirsium ownbeyi*	G3/S2 RSFO	Sparsely vegetated shaley slopes in sage and juniper communities 6440 to 8400'	Probable
Wyoming tanseymustard	*Descurania torulosa*	G1/S1 RSFO	Sparsely vegetated sandy slopes at base of cliffs or volcanic breccia or sandstone 8300 to 10000'	Low
Large-fruited bladderpod	*Lesquerella macrocarpa*	G2/S2 RSFO	Gypsum-clay hills and benches, clay flats and barren hills 7200 to 7700'	Low

Common Name	Scientific Name	Status[2]	Habitat	Occurrence Potential[3]
Stemless beardtounge	*Penstemon acaulis* var. *acaulis*	G3T2/S1 RSFO	Cushion plant or black sage grassland communities on semi-barren rocky ridges, knolls, and slopes 6500 to 7000'	Low
Beaver Rim phlox	*Phlox pungens*	G2/S2 RSFO	Sparsely vegetated slopes on sandstone, siltstone, or limestone substrate 6000 to 7600'	Low
Tufted twinpod	*Physaria condensate*	G2/S2 RSFO	Sparsely vegetated shale slopes and ridges 6500 to 7000'	Low
Green River greenthread	*Thelesperma caespitosum*	G1/S1 RSFO	White shale slopes and ridges of Green River formation 6300'	Low
Uinta greenthread	*Thelesperma pubescens*	G1/S1 RSFO FSR4	Sparsely vegetated benches and ridges on coarse, cobbly soils of Bishop Conglomerate 8500'	Low
Cedar Mountain Easter daisy	*Townsendia microcephala*	G1/S1 RSFO	Rocky slopes of Bishop Conglomerate 8500'	Low

[1] - Source: USDI-BLM (2002), WYNDD (2003).
[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).

WGFD Native Species Status Codes - Fish and Amphibians

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.

WGFD Native Species Status Codes - Birds and Mammals

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).

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).

Potential habitat exists within the project area for Wyoming pocket gophers. There has been one documented occurrence of a Wyoming pocket gopher approximately 2 mile west of the PRPA (WYNDD 2003) and it is likely that this species occurs within the PRPA.

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 2003a) or the WYNDD (2003). The project area is primarily dominated by Wyoming big sagebrush and it is possible that pygmy rabbits could occur on the project area. J. Dunder (RSFO wildlife biologist) feels that the species may occur within the project area; therefore, stands of tall sagebrush should be avoided where possible.

White-tailed Prairie Dog. See Section 3.8.1.1.

3.8.2.2 Birds

Fourteen sensitive bird species may potentially be found on the PRPA (USDI-BLM 2002; Table 3-17). These include: mountain plover, sage sparrow, Brewer's sparrow, long-billed curlew, yellow-billed cuckoo (see Section 3.8.1.2), sage thrasher, western burrowing owl, loggerhead shrike, greater sage-grouse, white-faced ibis, trumpeter swan, peregrine falcon, ferruginous hawk, and northern goshawk. The RSFO requested that the mountain plover, greater sage-grouse, sage thrasher, loggerhead shrike, Brewer's sparrow, sage sparrow, and burrowing owl be considered in more detail. The ferruginous hawk is known to occur in the PRPA and is discussed collectively in the raptor section (Section 3.7.1.8).

Mountain Plover. The mountain plover was previously proposed for listing as threatened, however, on September 9, 2003 the mountain plover was removed from proposed status (Federal Register 2003). 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 five percent. Any short grass, very short shrub, or cushion plant community could be considered mountain plover nesting habitat (Parrish et al. 1993), however, mountain plovers prefer shortgrass prairie with open, level, or slightly rolling 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 2003) or WYNDD (2003). Areas providing potential mountain plover habitat were mapped from the ground by HWA in early September 2003. Potential mountain plover habitat closely corresponded to the extent of the white-tailed prairie dog colonies. A total of 4,670 acres of potential mountain plover habitat was mapped, of which, 3,695 acres were located within the PRPA (Figure 3-17). Surveys to determine the presence/absence of mountain plovers within the potential habitats may be conducted in the spring of 2004. Surveys would be performed in accordance with the USFWS guidelines (USDI-FWS 2002).

Greater Sage-grouse. The greater sage-grouse is the upland game bird of primary interest in the project area. The sage-grouse has declined over much of its range in the western states during recent years and has been 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. 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. Locations of known sage grouse leks on and within two miles of the PRPA were obtained from the BLM Rock Springs Field Office and from the WGFD. According to these records, four active leks are located on and within two miles of the PRPA (three leks within the project area boundary and one lek within the two-mile buffer of the project area; Figure 3-18). Because the status of these leks is known (active), no surveys of these leks would be required in the spring of 2004. The two-mile buffer of the four active leks, that area most likely to be utilized by nesting hens, covers approximately 16,731 acres (39%) of the PRPA.

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 for the sage thrasher occurs in the PRPA and the WGFD reported four records of sage thrashers occurring within six miles of the project area (WGFD 2003a). 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

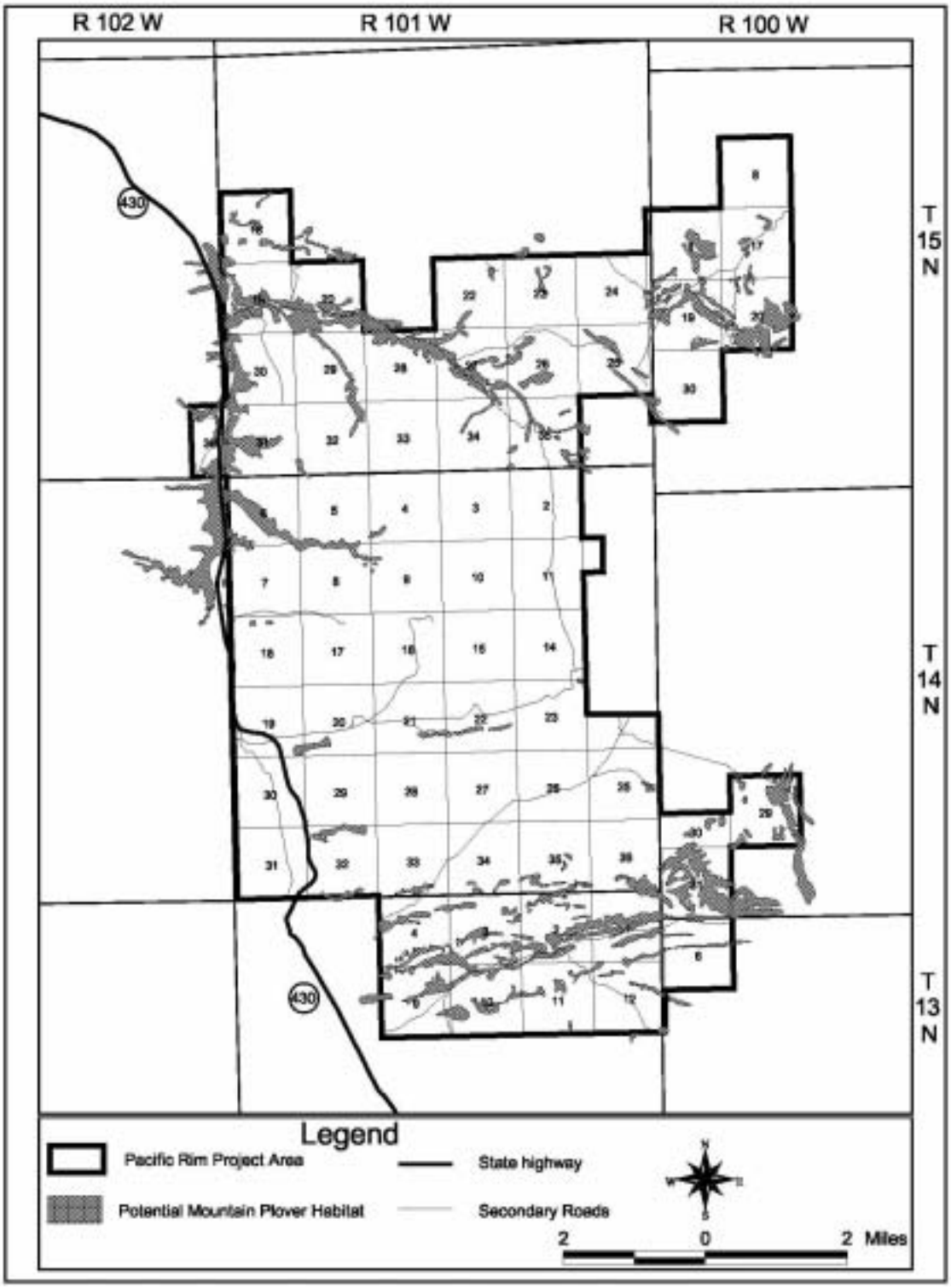


Figure 3-17. Potential mountain plover habitat in relation to the Pacific Rim Project Area.

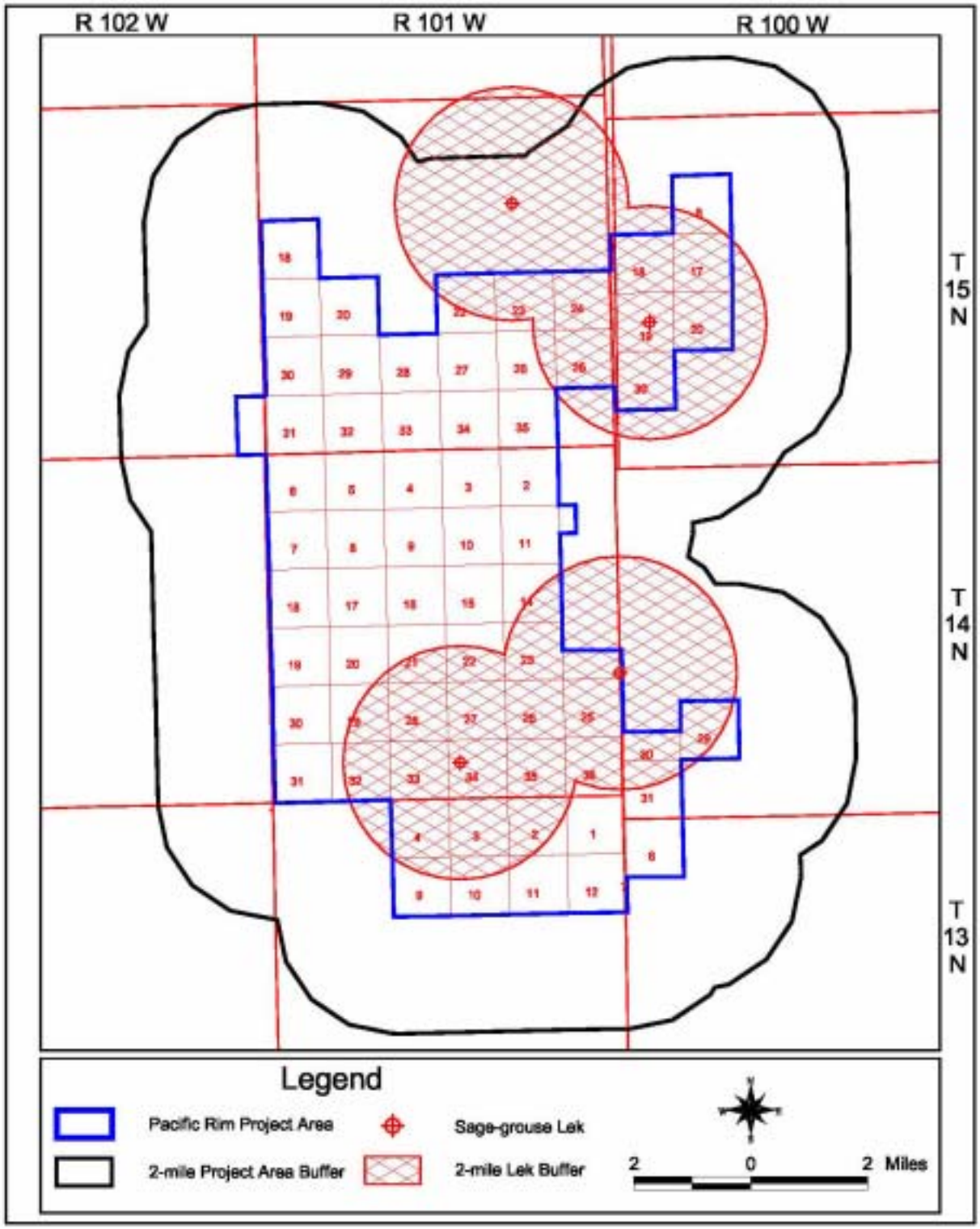


Figure 3-18. Greater sage-grouse leks in relation to the Pacific Rim Project Area.

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).

Three records of loggerhead shrikes are documented within six miles of the project area (WGFD 2003a) 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).

Four records of Brewer's sparrows are documented within six miles of the project area (WGFD 2003a, WYNDD 2003). 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).

One record of a sage sparrow was documented within six miles of the project area (WYNDD 2003). The project area is dominated by Wyoming big sagebrush and it is likely 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 burrowing owl numbers (Haug et al. 1993).

Two burrowing owl sightings have been documented within six miles of the project area (WGFD 2003a, WYNDD 2003) and HWA biologists observed burrowing owls at two locations within the PRPA in September 2003. The extensive white-tailed prairie dog colonies within the PRPA provide adequate nesting habitat for burrowing owls.

3.8.2.3 Reptiles

The midget-faded rattlesnake may potentially be found on the PRPA (USDI-BLM 2002; Table 3-17). No records of midget-faded rattlesnakes are documented within six miles of the project area (WGFD 2003a, WYNDD 2003). The likelihood that the midget-faded rattlesnake occurs on the PRPA is low due to a lack of suitable habitat.

3.8.2.4 Amphibians

Four sensitive amphibian species may potentially be found near the PRPA (USDI-BLM 2002; Table 3-17). The boreal toad, northern leopard frog, and spotted frog are unlikely to occur on the PRPA; the Great Basin spadefoot toad has a slight potential to occur, and it is considered in more detail.

Great Basin Spadefoot Toad. In Wyoming, the Great Basin spadefoot occurs in sagebrush communities mostly west of the Continental Divide (Baxter and Stone 1992). 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).

One record of a Great Basin spadefoot toad was documented in 1945, approximately seven miles east of the PRPA (WYNDD 2003). Although limited habitat exists in the PRPA, it is possible that Great Basin spadefoots may occur on the project area, where they may utilize intermittent and temporary water sources for breeding during years with adequate moisture.

3.8.2.5 Plants

Fifteen sensitive plant species have the potential to occur on or near the PRPA (USDI-BLM 2002). A summary of status, habitat associations, and potential of occurrence in the project area for the species are shown in Table 3-17.

Two BLM sensitive species known to occur near the project area include Nelson's milkvetch (*Astragalus nelsonianus*) and Wyoming tansymustard (*Descurainia torulosa*). The following discussion on these species is based on information provided by J. Glennon, RSFO Botanist (2004).

Nelson's milkvetch. Nelson's milkvetch is found all around the project area with the closest known population occurring more than 10 miles from the PRPA boundary. Potential habitat for this species is present on the project area. Not all of the PRPA has been surveyed and the possibility exists that it may be found during required BLM surveys.

Wyoming tansymustard. Wyoming tansymustard is known to occur north and northwest of the PRPA. It has been found closer than one mile from the project area boundary. There is some

potential habitat for this species within the project area but it is generally located on steep slopes in areas that may be avoided in BLM's standard stipulations.

3.8.2.6 Fish

Fish species that are not listed as endangered or threatened by the FWS, but may be rare or declining in the state in the future, have been included on the BLM Wyoming Sensitive Species List (USDI-BLM 2002). Five sensitive fish species occur within the Rock Springs Field Office area (Table 3-17). These include: leatherside chub (*Gila copei*), roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), and Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*). Three of these species are known to occur in streams downstream of the PRPA. These include the roundtail chub, bluehead sucker, and flannelmouth sucker (WYNDD 2003, USDI-BLM 2002). All three species are present in the Green River downstream of the PRPA, while the bluehead sucker and flannelmouth sucker have been collected in Bitter Creek (WGFD 2004). WGFD is entering into a cooperative agreement with other states where these three non-game species are present. The goal of the cooperative agreement is to manage these species to prevent them becoming threatened or endangered. Likewise, it is BLM policy (BLM manual 6840) to manage sensitive species to preclude the need for listing under the ESA.

All of the streams within the PRPA are ephemeral and, therefore, do not have the potential to support BLM Wyoming state sensitive fish species on a year-round basis. Studies indicate that the non-game, native species may ascend ephemeral tributary streams to spawn (Maddux and Kepner 1988, Weiss et al. 1998). Thus, ephemeral drainages fed by runoff from the project area may provide habitat for sensitive fish on a seasonal basis only.

3.9 RECREATION

3.9.1 Introduction

The recreation resources of the PRPA, located within the vast Green River Basin of Wyoming, support only dispersed recreation because the area contains no developed recreation sites or facilities. Although the PRPA contains some private land areas, almost all recreation occurs on public land managed by the BLM.

Hunting is the main recreation use in the PRPA. The PRPA also attracts visitors who enjoy tracing historic trails and viewing wild horses and other wildlife. Camping and recreational use of off-highway vehicles (OHV) in the PRPA is almost entirely an accessory activity to other recreation, mainly hunting. There are no resources for sport fishing in the PRPA.

The PRPA is located within a larger region that the BLM places in visual resource management (VRM) category IV. For this category, the BLM's policy is to provide for activity that requires major modification of the existing character of the landscape. In fact, the PRPA already reflects some landscape change due to existing gas development (Foster 2003).

There are no recreational visitor data available for the PRPA, so characterization of the area's current use for recreation is possible only in very general terms. What is known is that recreation use of the PRPA is affected by several factors. First, the quality of recreational resources and

settings, including areas used for hunting, is not unique compared to the lands of the BLM's RSFO as a whole and are generally not the kind that attract use from a wide area. Second, there are few population centers near the PRPA and those that are nearby are small. Finally, the PRPA contains no significant natural or historic sites, though it does overlap the visual setting of historical Cherokee Trail segments south of the PRPA.

The information presented here on recreation resources is based on interviews with agency personnel and information from published documents, including the Green River Resource Management Plan (BLM 1997).

3.9.2 Recreation Resources and Use

The principal recreation resources of the PRPA are public lands managed by the BLM. These resources mainly support big-game hunting. There is also some non-consumptive recreation, consisting mainly of historic trail visits and wild horse viewing.

3.9.2.1 Hunting

Some big game animals are hunted in the PRPA, and habitat within the PRPA does include some crucial big game winter range. The PRPA also supports some sage-grouse hunting, and the area contains some sage-grouse seasonal restriction areas (BLM 1997). (See section 3.8 for a discussion of greater sage-grouse). Hunting for mule deer, elk, antelope and sage-grouse occurs generally from September through October. Small game hunting also occurs in late fall and winter in the PRPA, as it does in habitat of various kinds throughout the RSFO and the state of Wyoming as a whole.

Table 3-18 presents data on hunting use reported by the WGFD for the entirety of hunt areas that contain the PRPA. These hunt areas generally extend from I-80 to Wyoming-Colorado border and from WYO 430 east to the Antelope Creek and Shell Creek drainages east of Kinney Rim for antelope and mule deer and east to WYO 789 for elk.

Table 3-18. Estimates of Hunting in 2002 for WGFD Hunt Areas Containing the PRPA

Game Species	Hunt Area Involved	Total Hunters	Non-Resident Hunters	Hunter Success, All Hunters	Average Days per Hunter, All Hunters
Antelope	53 Black Butte-Kenny Rim	185	23%	87%	3.4
Mule Deer	101 Black Butte	123	23%	59%	5.9
Elk	124 Powder Rim	67	13%	61%	6.4
Sage Grouse	6 Flaming Gorge	86	NA	NA	1.8

Source: WGFD 2002; Lloyd Levy Consulting.

Two areas near but not in the PRPA that contain a better-than-average habitat and setting for hunting are the Pine Mountain area, 10 miles southwest of the PRPA, and the Pine Butte area,

which adjoins the PRPA to the northeast. The BLM has designated the Pine Mountain area a Recreation Use Area (RUA) (BLM 1997). In August 2003, the Pine Mountain RUA sustained resource damage in the Four Rim Fire (BLM 2003). The area surrounding Pine Butte is categorized as VRM Class II for visual quality (BLM 1997). Class II lands are managed to retain the existing character of the landscape, so this classification allows a low level of change to the characteristic landscape (BLM n.d. [a]).

Most hunting in these larger hunt areas is of local importance. However there is some hunting of big game species by out-of-state residents indicated by the data for the entire hunt areas (WGFD). These data, as presented in Table 3-18 for the hunt areas as a whole, may or may not represent the particular character of the part of each hunt area that is contained in the PRPA. No data for hunting are available exclusively for the PRPA (Foster 2003).

3.9.2.2 Other Recreation

The PRPA is near a historic trail that does support recreational use. The Cherokee Trail corridor, which is roughly aligned with the Vermillion Creek drainage, passes within a mile-and-a-half south of the PRPA boundary (BLM n.d. [b]). Recreation use of trail segments near the PRPA consists mainly of individual and group visits to experience the site and its setting or to reenact history on the actual trail. Under the existing RMP (BLM 1997) the Cherokee Trail is managed like a National Historic Trail, and bills to give it formal designation have been introduced in recent sessions of Congress. Users of the Cherokee Trail near the PRPA have included wagon train reenactments in recent years (Del Bene 2004). Another known trail, the Pine Butte variant of the Overland Trail, crosses the northeast corner of the PRPA but is not considered eligible for protected status (Del Bene 2004).

The PRPA is entirely within the Salt Wells Wild Horse Herd Management Area (WHHMA) (RMP exhibit). Observing wild horses is popular for recreation in the GRRA, and county roads entering the PRPA, including SCR 24, SCR 77 and SCR 19, are used to view wild horses. At present, use of county and BLM roads for wild horse viewing occurs simultaneously without much conflict with other resource uses of the area, including existing oil and gas development and associated operations and maintenance activities (Foster 2003). The PRPA contains no designated wild horse herd viewing areas.

Recreational camping and off-highway vehicle (OHV) riding, both popular on public lands throughout Wyoming, occur in the PRPA as accessory activities to the primary use of the area's resources, such as hunting, historic trail visits and wild horse viewing. There are no developed campsites or OHV free-use areas in the PRPA (Foster 2003).

3.9.3 Recreation Plans

The BLM and Sweetwater County have land use plans in place that address recreational land use. This section reviews existing goals and objectives for recreation from these plans that address the recreation resources and uses of the PRPA.

BLM recreation resource management objectives for the RSFO are to ensure continued availability of outdoor recreational opportunities while protecting other resources, meeting legal requirements for the health and safety of visitors, and mitigating conflicts between recreation and other types of

resource uses (BLM 1997).

The Sweetwater County Comprehensive plan was approved in August 2002. The plan is a framework for the creation, administration and enforcement of land use regulations to be written and adopted in the future. This plan calls for the recognition and protection of unique recreational resources, identification of recreation areas that are suitable and desirable for preservation as open space, promotion of public agency awareness of recreation as a county issue and interest, and inclusion of representation for recreation on the county's Public Lands Committee (Sweetwater County 2002).

3.10 VISUAL RESOURCES

The Pacific Rim Shallow Gas Project Area (PRPA) is located within the Wyoming Basin physiographic province. The province is a large and variable region that contains high plains of 5,000 feet to 8,000 feet in elevation, broken by isolated hills, low mountains and eroded badlands that range in elevation from 1,000 feet to 2,000 feet.

The information presented here on visual resources is based on a site visit, interviews with agency personnel and information from agency documents, including the Green River Resource Management Plan (RMP) (USDI-BLM 1997).

3.10.1 General Visual Characteristics

The PRPA generally occupies a broken, high-plains landscape partially encircled by Rife's Rim, an escarpment that is generally about 7,700 feet in elevation. The topography of the central part of the PRPA is defined by the benches and draws below the Rife's Rim escarpment. To the south, a portion of the PRPA includes rolling, northward upslope to Rife's Rim. To the northeast, a "thumb" of the PRPA encompasses a saddle between Rife's Rim and Kinney Rim.

Pine Butte (approximately 8,800 feet in elevation) is the high point on Kinney Rim that is immediately northeast of the PRPA. Although Pine Butte is visible from the PRPA and has views into the PRPA, it is located outside the PRPA boundary. Another prominence, Pine Mountain (approximately 9,550 feet in elevation), is visible in the distant background southwest of the PRPA.

The down-cut bed of East Salt Wells Creek (ranging from 7,700 feet to 6,980 feet as it drains northward) and paved, two-lane WYO 430 generally define the western edge of the PRPA. Tributaries to East Salt Wells Creek flow west from Rife's Rim, passing through a number of draws. Rife's Rim divides the southern part of the PRPA from the north. Drainages from the "east slope" of Rife's Rim flow to the North Fork of Vermillion Creek, which runs on a southeasterly course south of the project area. The saddle in the northeast thumb of the PRPA (approx 7,490 feet) is on the divide between the Salt Wells Creek and North Fork drainages.

Landscape character in the PRPA varies from north to south. The northern edge, referred to by the Operator as the Pacific Isle unit, is broken country with scattered pinion and juniper cover. Most of the remainder of the project area, named the Rife's Rim unit, is a sloping brush covered plain. The northeast part of the PRPA, approaching Pine Butte, contains the upper end of Alkali Creek, a tributary of Vermillion Creek, and has some riparian area.

Much of the land within the PRPA has been culturally modified, primarily through grazing. Grazing areas usually contain livestock fencing and some non-native plant species. Beginning in 1954 and prior to recent development activity, one producing well was drilled and developed, five natural gas wells were drilled and shut in, and ten non-producing wells were drilled, plugged, and abandoned (BLM n.d.[c]). Since 2003, Warren E & P has been developing an exploratory "pod," (producing and processing unit) consisting of nine wells and ancillary facilities. The appearance of the surface in this area, centered on Section 31, Township 15, Range 101, is highly disturbed as construction continues on water and gas gathering systems.

3.10.2 Visual Resource Objectives within the PRPA

The BLM uses its own Visual Resource Management (VRM) system to measure the scenic value of the public land under its jurisdiction and to establish priorities for management of the visual resources in conjunction with other resource. The VRM classification of the project area helps to establish the minimum degree of contrast that is acceptable between the project and the major features of the existing landscape (BLM n.d. [a]).

All of public land within the PRPA is classified in VRM Class IV, the lowest scenic value classification. Management actions permitted on public lands with a Class IV VRM classification could result in major modification of the character of the landscape (USDI-BLM 1997).

3.10.3 Visual Resource Objectives for Other Resources

Although all land within the PRPA is classified in VRM Class IV, visual quality objectives for other resources overlap or are near the project area and may affect management and design of other permitted activities (USDI-BLM 1997).

Segments of the Cherokee Trail corridor, which is roughly aligned with the Vermillion Creek drainage, pass a mile-and-a-half south of the PRPA boundary (BLM n.d. [b]). Although the Cherokee Trail was omitted from the National Historic Trail System Act of 1992, bills put before recent Congresses have included the trail, and the trail is to be added to the system in the future (Del Bene 2004). The Cherokee Trail is considered eligible for the National Register of Historic Places.

Management objectives for trails with historic status include protection of landscape quality in areas comprising the visual setting and contributing to the historical and cultural character. The visual setting is areas visible in the foreground/middle-ground "distance zone" (BLM (n.d. [a]), defined as five miles from the trail's route. "Best management practices," mainly involving the manipulation of location and design attributes of facilities, are typically used to eliminate or reduce potentially adverse effects to the setting of contributing trail segments (Del Bene 2004).

Another known trail, the Pine Butte variant of the Overland Trail, crosses the northeast corner of the PRPA but is not considered eligible for protected status. Therefore, there are no visual resource management objectives for the setting of this trail (Del Bene 2003).

Under current RMP, the Pine Mountain Management Area (PMMA), which contains the Cherokee Trail segment, is a Geographic Management Area being managed to ensure adequate maintenance

of a combination of resource values (BLM 1997). The PMMA is in VRM Class III. At its closest the PMMA is less than one-fourth mile from the PRPA. Management actions permitted on Class III lands would be designed to partially retain the existing character of the landscape (USDI-BLM 1997).

Northeast of the PRPA, the land immediately surrounding Pine Butte is in VRM Class II. At its closest, the VRM Class II land surrounding Pine Butte is less than one-half mile from the PRPA boundary. Management actions permitted on Class II lands would be designed so as to retain the existing character of the landscape (USDI-BLM 1997).

3.11. CULTURAL AND HISTORICAL RESOURCES

3.11.1 Summary of Extant Cultural Resources

The Cultural Records Office (CRO) in Laramie provided information on the previous work conducted in the Pacific Rim analysis area and previously recorded sites. Records at Western Archaeological Services (WAS) were consulted as well as records at the Rock Springs Field Office (RSFO) of the BLM. There have been 22 projects conducted and 76 sites recorded in the study area. Of these, there are 20 Class III block and linear surveys (including two seismograph or geophysical surveys), and two Class II sampling surveys. Limited amounts of previous work in the study area have resulted in the documentation of cultural resources through survey, examination of ethnographic records, and historic record research. No excavations have been conducted in the Pacific Rim study area. The Pacific Rim study area encompasses approximately 74.4 square miles or 47,597.82 acres. Approximately 1372 acres (block) or ca. 2.9% of the project area have been inventoried for cultural resources at a Class III level. The Salt Wells Class II Sampling survey (Treat and Tanner 1981), East Salt Wells Zone (Stratum 8), encompassed 66, 581.1 acres which included a portion of the Pacific Rim study area. A series of linear transects were surveyed through the East Salt Wells Study Area in 1981. The project specific site density per acre can not accurately be calculated because there are no acreage calculations at the CRO for the linear projects.

The overall site density within the study area varies with the highest number of sites located along drainages, in sand deposits, and in the juniper trees. Limited amounts of work previously conducted in the study area documents the highest density of sites recorded along Schreggs Draw, Alkali Creek, along unnamed ephemeral drainages of East Salt Wells Creek, and in the dunal deposits and juniper trees on the ridges east of East Salt Wells Creek. Twenty of the previously recorded sites within the Pacific Rim study area were documented during the Salt Wells Resource Area, East Salt Wells Zone, Class II inventory in 1981 (Treat and Tanner 1981). Twenty-nine newly identified sites were documented and one previously recorded site was relocated during the 2003 Pacific Rim Block Survey (Kautzman 2003) conducted for Petroleum Development Corporation. These two projects account for 50 (66%) of the 76 recorded sites in the study area.

Site types

The 76 sites in the project area include 60 (79%) prehistoric sites, 9 (11.8%) historic sites, 5 (6.6%) structures including rock alignment, cairns, rock piles, or rock shelters, and 2 (2,6%) prehistoric/historic sites. Of the recorded cultural resources, 25 (33%) are recommended eligible

for nomination to the National Register of Historic Places (NRHP), 5 (6.5%) are eligible with State Historic Preservation Office (SHPO) concurrence, 9 (11.8%) are recommended not eligible for nomination to the NRHP, 4 (5.3%) are not eligible with SHPO concurrence, and 33 (43.4%) remain unevaluated.

Prehistoric sites

Prehistoric sites consist of camps that contain evidence of a broad range of activities including subsistence-related activities. Formal features, lithic debris, chipped stone tools, beads, 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.

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.

Human burials, rock alignments, and rock art have been identified as sensitive or sacred to Native Americans. There are no human burials documented in the Pacific Rim study area. One unknown rock alignment was documented in the northeastern portion of the study area (Treat and Tanner 1981). A stone pile was recorded during the Pacific Rim Block Survey (Kautzman 2003) and Native American consultation was completed. Rock alignments have been documented on Aspen Mountain located northwest of the study area. Rock art, recognized as pictographs or petroglyphs, is unknown in the project area. However, immediately south of the Pacific Rim study area, several panels of charcoal pictographs typical of Ute or Shoshone are located in the Upper Powder Springs complex as well as pecked trapezoidal anthropomorphic figures (Murcray 1993). Some of the pictographs were faded with time but had been painted red. Petroglyphs are also documented north of the Mud Springs Ranch on WYO 430. It is important to be cognizant of the possibility of similar resources in the project area.

Pottery/ceramics are unknown in the study area but have been documented to the north along Cooper Ridge. Gray ware and brown sherds are associated with the Uinta phase of the Late Prehistoric period.

Consultation with appropriate Native American tribes concerning areas of concern to them 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-BLM 1997).

Historic Sites

A cabin is recorded east of Scheggs Draw and a windmill is recorded at the confluence of East Draw with East Salt Wells Creek. Two historic debris sites have been documented in the study

area. The earliest water rights documented in the drainages surrounding the Pacific Rim study area include appropriations by Rife for three ditches off Vermillion Creek including the West Fork of Vermillion Creek, the North Fork of Vermillion Creek, and Vermillion Creek in 1886; the School ditch in 1908; and the Farley No. 1, 2, and 3 ditches in 1909. Rife also appropriated water rights on Coyote Creek for the Schrivner No. 1 and 2 and the McKnight Nos. 1, 2, and 3 ditches. Gottsche appropriated water rights on the South Fork of Red Creek in 1902 for the Jones ditch. The use to which the water rights were applied included domestic use, irrigation, and stock dams (Freeborn 1926).

The Pine Butte Variant of the Overland Trail is generally located north of the study area but does traverse the northwestern-most zone of the study area. The Pine Butte Variant of the Overland Trail (48SW1226) as documented by Lowe (2001) "appears to be plausible and viable, but not extraordinarily significant, alternative Expansion-era freight road and emigrant route that deviated from the main Overland Trail to the southwest at the former LaClede Overland trail stage station on Bitter Creek, then continued in a westerly direction then northwest to either Salt Wells, Rock Springs, or Green River on the main Overland route." Because the variant does not meet essential criteria for NRHP eligibility under Criterion A, B, or C, the site is documented not eligible for inclusion on the NRHP with SHPO concurrence.

The Cherokee Trail has been identified south of the project area. The Cherokee Trail was used in the 1850s by members of the Cherokee Tribe moving from the Oklahoma Reservation to the California gold fields. As depicted on the 1882 GLO maps, the Southern Variant of the Cherokee Trail trends across southwestern Wyoming and northwestern Colorado, ascending Powder Rim and trending west along the rim to Vermillion Creek. The Cherokee Trail crosses the ridge between Sage and Current creeks and continues west/northwest to the Green River.

As with any of the westward migratory trails of the mid 1800s, variants have been documented. Reasons for variations in routes include inaccessibility at certain times of year or members of the group may have traveled the route previously and found an easier or more direct avenue to water. The route of the Cherokee Trail depicted on the USGS quadrangle maps does not exactly match the route of the trail depicted on the 1882 GLO maps.

Excerpts from Cherokee Trail diarist found in *Cherokee Trail Diaries* (Fletcher et al. 1999) document stops along the southern variant of the Cherokee Trail. Brown(1850) at Vermillion Creek:

> "July 15...20 miles...Man & Beast sick. Caused by drinking the water that we have been drinking for several days. Traveled today 20 miles and came to a narrow swift Branch of good cold water with tolerable good grass – Camp 64–."

The Cherokee Trail (48SW3680) is an historic linear property located south of the Pacific Rim study area. The viewshed of the Cherokee Trail extends north into the southernmost portion of the project area. The Cherokee Trail is recommended eligible for inclusion on the NRHP. Management of historic roads and trails that are eligible for the NRHP but are not congressionally designated will generally be the same as for designated trails including a ¼ mile protective setback on either side of the trails (USDI-BLM 1997).

The Outlaw Trail is purported to be near the project area. There is no formal documentation of the

trail showing its exact location. The trail was used by the outlaws to go “from Brown’s Hole north to Hole-in-the-Wall in Johnson County, Wyoming” (Kelly 1959). Historic accounts of the outlaw movements place them in Rock Springs, Green River, and Powder Springs. However, the location of the trail is largely unknown and its exact locale will be difficult to ascertain.

The Rock Springs to Browns Park Freight Road (48SW3865) and the Rock Springs to Hiawatha Road (48SW10752) follow the same route south from Rock Springs through the westernmost portion of the study area superceded in part by what is now Wyoming Highway 430. The Rock Springs to Hiawatha Road departs the Rock Springs to Browns Park Road south of the study area and trends east to the Hiawatha gas fields whereas the Rock Springs to Browns Park Road continues south into Browns Park, Colorado. The Rock Springs to Browns Park Road underwent two distinct phases of development. The first phase constituted a two-track road connecting the rural ranching population from Brown’s Park in Utah and Colorado and southern Sweetwater County with Rock Springs. The second phase of development of the Rock Springs to Browns Park Road came about because of the gas deposits identified in the Hiawatha Dome field (Johnson 1997). The Rock Springs to Browns Park road is recommended eligible for inclusion on the NRHP under Criteria A. The route is documented as an interstate trail which connected the railhead at Rock Springs to Browns Park in northeast Utah and northwest Colorado. The Rock Springs to Hiawatha Road is recommended not eligible for inclusion on the NRHP with SHPO concurrence.

Rife’s Road to Bitter Creek (48SW12070) was originally used to provide supplies to winter range sheep camps. Rife’s Road to Bitter Creek is a two-track road that departs the Guy Rife Ranch south of the Pacific Rim study area trending northerly to East Salt Wells Creek, then parallels the creek (modern WYO 430). The road then trends northeasterly into Scheggs Draw and eventually becomes Sweetwater County Road 24 (Patrick Draw Road). The route follows this improved road for six miles before continuing to the northeast for an additional ca. 25 miles to the railroads at Bitter Creek. Portions of the road have been upgraded at various times starting in the early 1900s by Sweetwater County. Later upgrades in the Bitter Creek area and around Scheggs Draw were upgraded for use by the oil and gas industry, however the majority of the road remains a two-track (Ficenec 1998). Rife’s Road to Bitter Creek (48SW12070) is considered not eligible for the NRHP with SHPO concurrence.

Excavation Data

Test excavations at the Mud Spring Ranch site (48SW1670), located immediately north of the study area, resulted in the documentation of a multi-component site. The artifact analysis for Mud Springs shelter indicates that the site was a base camp from which both hunting and gathering activities were conducted (Creasman 1998). Artifacts from Mud Springs Shelter representing the Late Prehistoric period include a steatite pipe, a pottery vessel, a bone awl, two bone beads, carved wood, Rose Spring, Uinta side-notched, and Cottonwood style projectile points. Historic artifacts were limited to six shell casings and bullets dating between 1866 and present.

Site 48SW11483, Alkali Creek site, located southwest of the study area is a multi-component site. Data from the excavation place the occupation of the site to the Pine Spring and Deadman Wash phases of the Late Archaic period. The composition of cultural material produced by each occupation at the Alkali Creek site, particularly the bone refuse, lithic debitage, and artifact types, is characteristic of a class of mobile hunter-gatherer camps recognized by Binford (1980) and Bertram et. al. (1991) as short-to-moderate duration residential occupations (Murcray 2003). Analyses of material recovered from the site indicate the consumption of large game supplemented by small game species and plant exploitation.

Summary

The subsistence and settlement patterns in the study area reflect a hunter-gather 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 B. P. (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.

Significant cultural resources are found along the major ephemeral drainages and along the lower benches of escarpments that dominate the terrain in the study area (Treat and Tanner 1981). Kautzman (2003) notes prehistoric sites identified in the Pacific Rim Block Survey “are located along the broad northwest-southeast ridge system either near the top or along the side slopes or ridge fingers”, noting that no sites were identified during the block survey within the drainage bottoms. Previous work in the area, although limited in scope, would indicate culturally sensitive areas include drainages such as Alkali Creek, East Salt Wells Creek, and Scheggs Draw, as well as along juniper covered ridges. 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. Native American consultation in this area will be carried out with the Eastern Shoshone, Northern Ute, Northern Arapaho, and Shoshone-Bannock Tribes should any sites of potential cultural significance to those tribes be found within or near proposed areas of disturbance.

Historic use of the project area was limited by terrain and lack of perennial water sources. The Pine Butte Variant of the Overland Trail bounds the northern portion of the study area. The Rock Springs to Browns Park Freight Road and the Rock Springs to Hiawatha Road transverse the western border of the project area with parts of the routes now identified as WYO 430. Rifes Road to Bitter Creek also parallels the western boundary of the study area trending north and then east toward the Union Pacific Railroad at Bitter Creek, Wyoming. The historic Cherokee Trail bounds the southern edge of the area. The Outlaw Trail may transverse the project area traveling between Rock Springs and Green River, Wyoming, and Brown’s Park, Colorado. No sites associated with the trail have been documented although local outlaw lore places notorious bandits such as Butch Cassidy and the Sundance Kid in the area. Some grazing and limited ranching activities are identified by the historic debris scatters and historic record.

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, and local government facilities and services, primarily law enforcement and emergency response services, however, the Proposed Action would also contribute to the overall natural gas industry-related demand for facilities and services currently

being experienced in Sweetwater County and its communities. The Proposed Action would also generate local, state and federal tax revenues.

For a detailed analysis of Sweetwater County population, employment, earnings and personal income trends through the year 2000, see the socioeconomic technical support document available for review at the Rock Springs Field Office. For a detailed analysis of population, employment, poverty and demographic trends for the City of Rock Springs, see the socioeconomic technical support document. The county and community profiles contained in these appendices were compiled using the *Economic Profile System*, which has been developed through a joint effort between the Sonoran Institute and the BLM. Copies of the *Economic Profile System* including databases and users manual are online at www.sonoran.org. A Technical Report including data from the Sonoran Institute concerning Sweetwater County, Wyoming, will be made available upon request.

In some cases, the data presented in Section 3.12 differ from the data contained in the technical support document, because different data sources, data series and methods were used to take advantage of more current information.

The area of analysis for potential socioeconomic impacts is Sweetwater County, Wyoming. As will be discussed below, the recent surge in natural gas development in the Green River Basin and throughout Wyoming is resulting in economic and population growth for Sweetwater County and its municipalities. Rock Springs has long been a regional oil and gas service center. Relatively sustained level of gas prices and advances in gas exploration and drilling technology have resulted in renewed interest in both conventional and unconventional gas reserves in the Green River Basin, in Wyoming and throughout the Rocky Mountain West. This interest has in turn resulted in growth in the oil and gas service industry in Sweetwater County, particularly over the past year.

Economic and demographic statistics are typically not available in real time; most lag current events by a year or more. Consequently, information about socioeconomic conditions in Sweetwater County during 2003 and early 2004 is primarily anecdotal, except for some 2003 employment statistics.

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 natural resource-based economy which is diversified, but relies heavily on natural resource extraction and processing. Basic sectors include oil and gas production and processing, trona mining and the manufacturing of soda ash and related products, coal mining and electric power generation, 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 to Sweetwater County (PIC 1996).

3.12.2.2 Employment, Unemployment and Labor Force

Sweetwater County total full and part-time employment grew from the 1990 level of 22,856 jobs to 24,804 jobs in 2001, growing by 1,948 jobs or about 9 percent. There was some volatility during the period, however. In 1994 total employment peaked at 25,177jobs (WEAD n.d. [a]). 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 two percent lower in 2002 (18,851) than in 1990 (19,231). As with the number of jobs discussed above, resident employment was substantially higher during 1994-1995 period. The 2002 Sweetwater County labor force (employed residents plus residents looking for work) ended the period at 19,790, about three percent lower than the 1990 level (20,348), after having dropped 802 or four percent between 2001 and 2002. The unemployment rate decreased from 5.5 percent in 1990 to 4.6 percent in 2001, but even with the 4 percent drop in employment between 2001 and 2002 the unemployment rate increased only to 4.7 percent, 0.1 percent higher than 2001 (WDE n.d.). The relatively stable unemployment rate in spite of decreasing employment reflected either out-migration (workers leaving Sweetwater County) or people withdrawing from the active labor force, either through retirement or ceasing to actively look for work, or some combination of these factors.

However, recently monthly statistics demonstrate substantial increases in employment and decreases in unemployment in Sweetwater County. December 2003 resident employment was 20,263, about 6 percent higher than December 2002 employment (19,103). The December 2003 Sweetwater County unemployment rate was 3.6 percent, 1.2 percentage points lower than the December 2002 rate of 4.4 percent. It should be noted that December is traditionally a low month for employment; indications are that employment was even higher in the months preceding December (WDERP 2004).

It should also be noted that the increases in employment described above include only resident employees. It is likely that many natural gas service employees in Sweetwater County are residents of other counties and states. Additionally, there appears to be a shortage of labor in Sweetwater County, many advertised positions go unfilled for long periods of time. (Robbins 2004).

3.12.2.3 Earnings

Sweetwater County earnings by place of work increased from $633 million in 1990 (1990 dollars) to $902 million in 2001 (2001$), a 42 percent increase over the eleven year period (WEAD n.d. [b]). This increase compares to a 68 percent increase in earnings for the State of Wyoming during this period. However, when adjusted for inflation, Sweetwater County earnings increased by about 24 percent during this period.

3.12.2.4 Recent Oil and Gas Activity

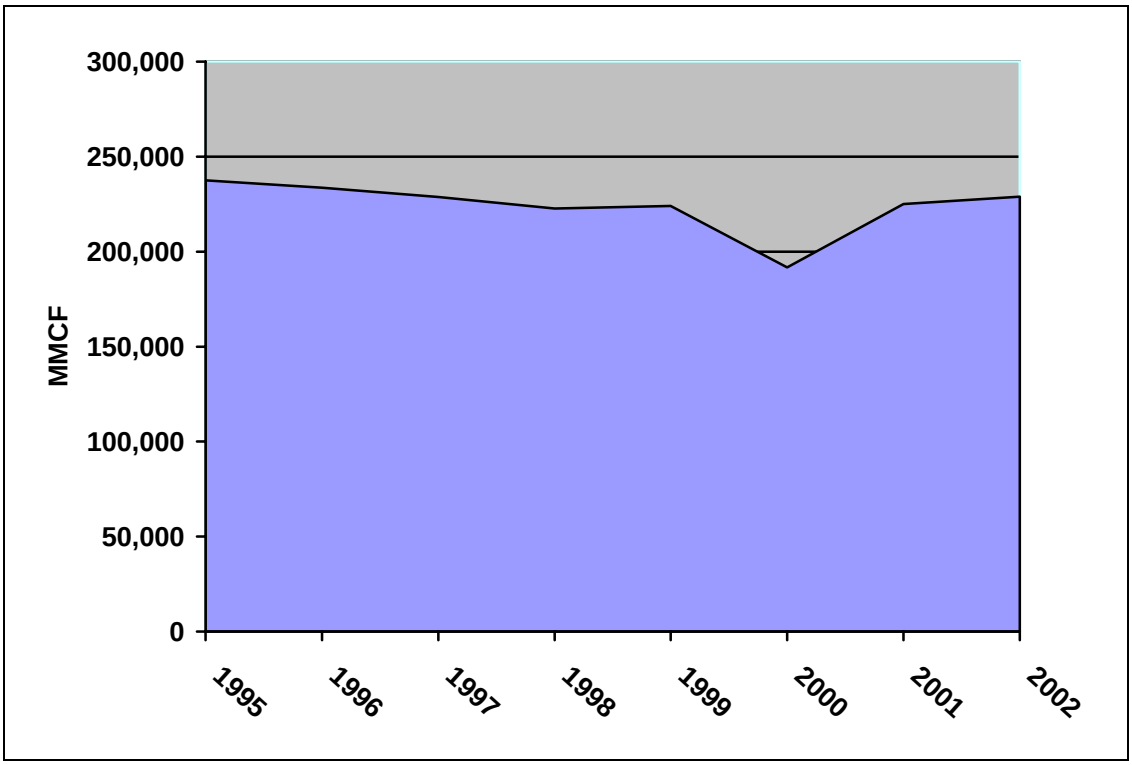
Production and approved applications for well drilling permits (APD) are two measures of oil and gas activity. As shown in Figure 3-19, annual natural gas production in Sweetwater County decreased from 238 million MCF in 1995 to 192 million MCF in 2000, but has since increased to about 229 million MCF in 2002. Sweetwater County production accounted for about 13 percent of all natural gas produced in Wyoming during 2002 (WOGCC 1995-2002).

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 3-20 below), 534 APDs were approved in the county during 2001, but that

number declined to 401 in 2002.

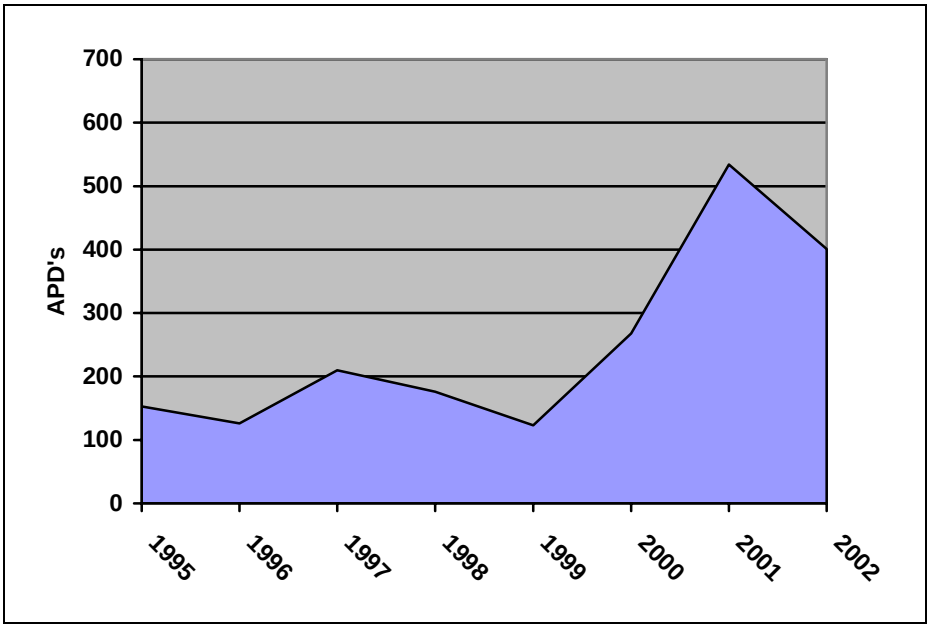
In 1995, there were a total of 1,544 producing wells (oil and gas) in Sweetwater County. By 2002, that number had increased to 2,521 a 63 percent increase over the 7 year period (see Figure 3-21). The acceleration of natural gas exploration, drilling and production which has occurred in Sweetwater County and adjacent areas of Wyoming and other Rocky Mountain states has correspondingly resulted in substantial expansion of the natural gas service industry in Sweetwater County (Robbins 2004).

Figure 3-19. Natural Gas Production for Sweetwater County 1995 – 2002



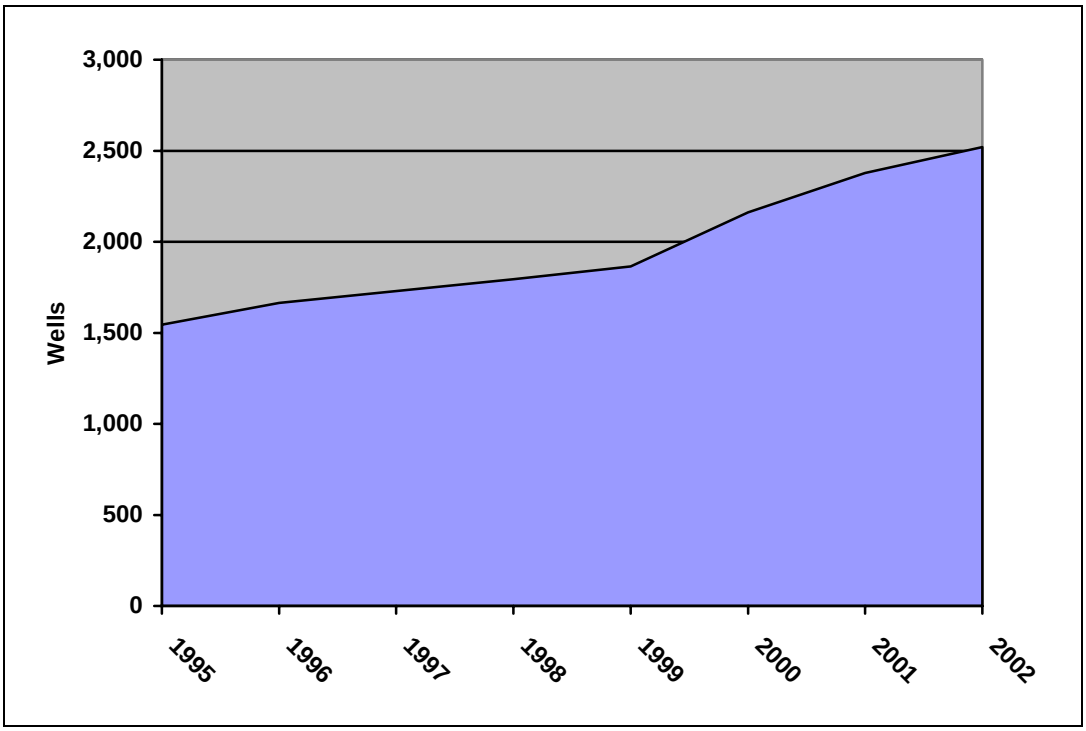
Source: WOGCC 1995-2002

Figure 3-20. Approved Sweetwater County Applications for Permits to Drill (APDs): 1995 – 2002



Source: WOGCC 1995-2002

Figure 3-21. Producing Oil and Gas Wells in Sweetwater County 1995 – 2002



Source: WOGCC 1995-2002

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. It is estimated that Sweetwater County population continued to fall in 2001, losing 2 percent of population, but rebounded to 37,194 in 2002 (refer to Figure 3-22) (WEA n.d. [c] & [d]).

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 3-19). Rock Springs lost another 2 percent of population between 2000 and 2001 but recovered about one percent in 2002. 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. Green River similarly continued to lose population in 2001 (another 2 percent) but made slight gains (1 percent) in 2002.

The most recent population forecasts available from the Wyoming Division of Economic Analysis projects that population levels in Sweetwater County will decrease 5 percent by 2010, to 35,400 (WEAD n.d. [d]); however, employment statistics and information obtained from Sweetwater County officials are that county population increased substantially during 2003 as a result of the increase in natural gas-related employment (Gordon 2004, Kot, 2004).

3.12.4 Housing

The nature of natural gas drilling and field development activities (relatively short duration tasks performed primarily by contractors) typically results in demand for temporary housing resources

such as motel rooms and mobile home and recreational vehicle (RV) spaces near the project area. 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 with over 1,900 pads (PIC 1997).

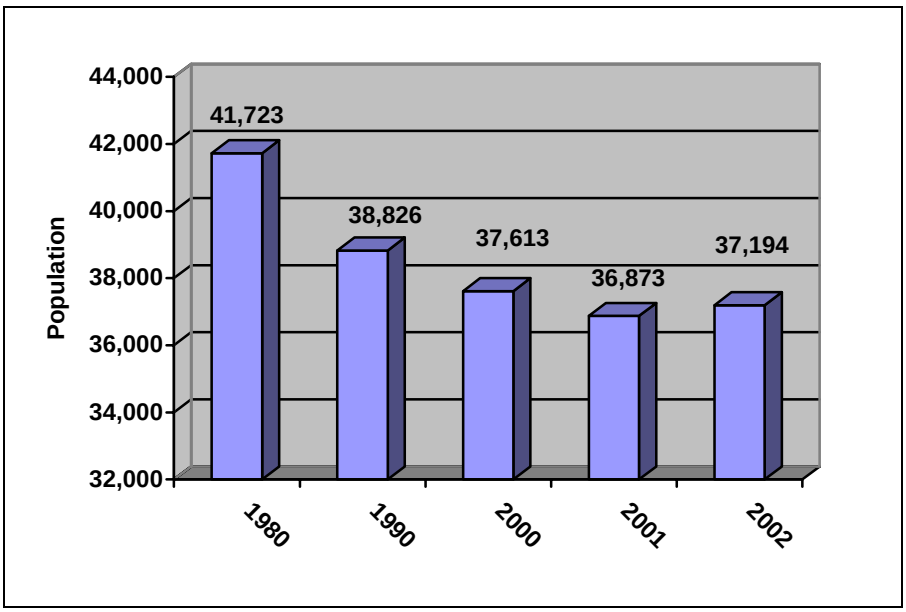
However, as Sweetwater County oil and gas service firms respond to increased natural gas development in the county, they are expanding their workforce and employees are seeking longer-term housing resources in the area. Vacancies in longer-term rental units (rental houses and apartments) in the Rock Springs/Green River area of Sweetwater County have been absorbed and most realtors and apartment owners have waiting lists (Robbins 2004, Scheer 2004).

Another indication of the growth in Sweetwater County is the absorption of homes for sale. Homes listed for sale in the Rock Springs/Green River multi-list service have decreased from several hundred several years ago to below 50 in each community, excluding homes under contract (Scheer 2004).

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 more people than currently reside in the county and its major cities. However, the contractions in population over the last decade resulted in corresponding contractions in county, municipal and human service agencies. As a result, these service agencies are having difficulty responding to the recent increases in demand associated with the increase in natural gas-related employment and population. The Sweetwater County Commissioners have begun the process of identifying natural gas-related service demand and approaching state government for assistance in responding to the demand (Gordon 2004, Kot 2004).

Figure 3-22. Sweetwater County Population: 1980, 1990, 2000 – 2002



Source: WDEA n.d. [c].

Law enforcement in the area surrounding the PRPA 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. Over the past year, calls for law enforcement services in and near natural gas fields have increased, including responses to traffic accidents, rig accidents and search and rescue calls in remote areas of the county (Scofield 2004).

Table 3-19. Population Estimates 1990 - 2002: Sweetwater County, Rock Springs and Green River

	1990	1995	2000	2001	2002
Sweetwater County	**38,823**	**40,635**	**37,613**	**36,873**	**37,194**
Rock Springs	**19,050**	**19,687**	**18,708**	**18,267**	**18,464**
Green River	**12,711**	**12,778**	**11,808**	**11,517**	**11,628**

Source: WEAD n.d. [d].

Emergency management in Sweetwater County is coordinated by the Sweetwater County Emergency Management Agency (SCEMA), which operates under Federal Emergency Management Agency (FEMA) and 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 PRPA 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, Utah or Craig and 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) 2003 assessed valuation was over $1.2 billion, 17 percent less than the previous year, and 2003 property tax revenues were $78.2 million, about 16 percent lower than 2002. These declines followed declines of 0.2 percent in assessed valuation and 0.7percent in property taxes during the previous year. Natural gas is assessed on the previous year's production. FY 2003 assessed valuation from 2002 natural gas production totaled $350 million or about 30 percent of total assessed valuation, which was about 39 percent less than the 2002 natural gas valuation of $578 million (WTPA 2002 & 2003). Current mill levies within the unincorporated portion of Sweetwater County which contains the PRPA total 71.26 mills, including 49.666 mills for State and local schools, a 12 mill county levy, .349 for weed and pest control, a 5 mill community college levy, 2.696 mills for county fire protection and 1.55 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 2003 sales and use tax collections in Sweetwater County totaled about $60.56 million, about 2 percent higher than the previous year. Of the total, about 86 percent is attributable to sales tax (WEAD 2003).

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 2003, severance tax distributions totaled $429 million, about 43 percent higher than FY 2002 (CREG 2003a). Of the total, about 54 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 2003, a total of $476 million in federal mineral royalty funds were distributed to Wyoming entities (CREG 2003b).

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).

The PRPA is relatively distant from population centers, so no populations (including low-income or minority populations) would be subjected to health or environmental impacts of development.

3.13 TRANSPORTATION

The regional transportation system serving the PRPA includes an established system of state highways and county roads. Local traffic on federal land is also served by improved and unimproved BLM and oil and gas field roads. Refer to Figure 3-23 for the transportation network.

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 (SCR) 4-24, 4-76, 4-77 and 4-19. Table 3-20 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 3-20. 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 PRPA 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.

Table 3-20. Highway Access to the Project Site.

Highway	Segment	1991 AADT	2000 AADT	2001 AADT	Level of Service
WYO 430	SCR 26 Intersection	290 (60 trucks)	250 (40 trucks)	170 (40 trucks)	A
	SCR 36 Intersection	280 (50 trucks)	150 (35 trucks)	130 (35 trucks	A

Source: WYDOT 2001

Sweetwater County Roads. The Sweetwater County Road and Bridge Department is responsible

for maintaining over 1,400 miles of county roads. Four Sweetwater County roads provide access to the PRPA: SCR 4-24, SCR 4-76, SCR 4-77, and SCR 4-19 (Gibbons 2004).

- SCR 4-24 (Patrick Draw Road) would provide access from WYO 430 and traverse the northern portion of the PRPA for about two miles. After exiting the project area on the north, SCR 4-24 extends northward about 30 miles to intersect with I-80. Although the northern portions of SCR 4-24 have been constructed and maintained for oil and gas field use, the portions in and near the PRPA currently receive considerably less industrial use.

- SCR 4-77 would provide access to the middle and southern sections of the PRPA. SCR 4-77 is also a native material road, seldom maintained by the county, constructed and maintained for ranch and grazing access.

- SCR 4-19 (Bitter Creek Road) would provide access to the southern portion of the PRPA about one quarter mile east of its intersection with WYO 430. SCR 4-19 traverses the southern portion of the project area for about 5 miles and exits the eastern boundary near Granary Draw, traveling about 40 miles further east and north to connect with I-80. SCR 4-19 is heavily used by oil and gas traffic in the northern segments, but less so in and near the PRPA.

3.13.2 BLM and Private Roads within the Project Area

A number of developed and undeveloped roads provide access to federal, state and private land within the PRPA. Like county roads, these roads are used by oil and gas operators, ranchers and grazing operators, and recreation visitors.

- SCR 4-24 intersects with an unnamed road that travels east and then south along the eastern boundary of the project area along Scheggs Draw.

- SCR 4-77 connects with two unnamed roads providing access to the north and to the east along East Draw.

- An unnamed road travels east from WYO 430 just south of the intersection with SCR 81. This road enters the PRPA and travels north and east, traversing the area south of Rifes Rim and dividing into north and south roads about one-half mile before exiting the eastern boundary of the project area.

- SCR 4-76 would provide access to a half-section of state owned land on the eastern boundary of the PRPA: about one-half mile of SCR 4-76 would be within the PRPA. SCR 4-6 was constructed and maintained for ranch and grazing access and occasional recreation use. It is constructed of native material and seldom maintained by the county.

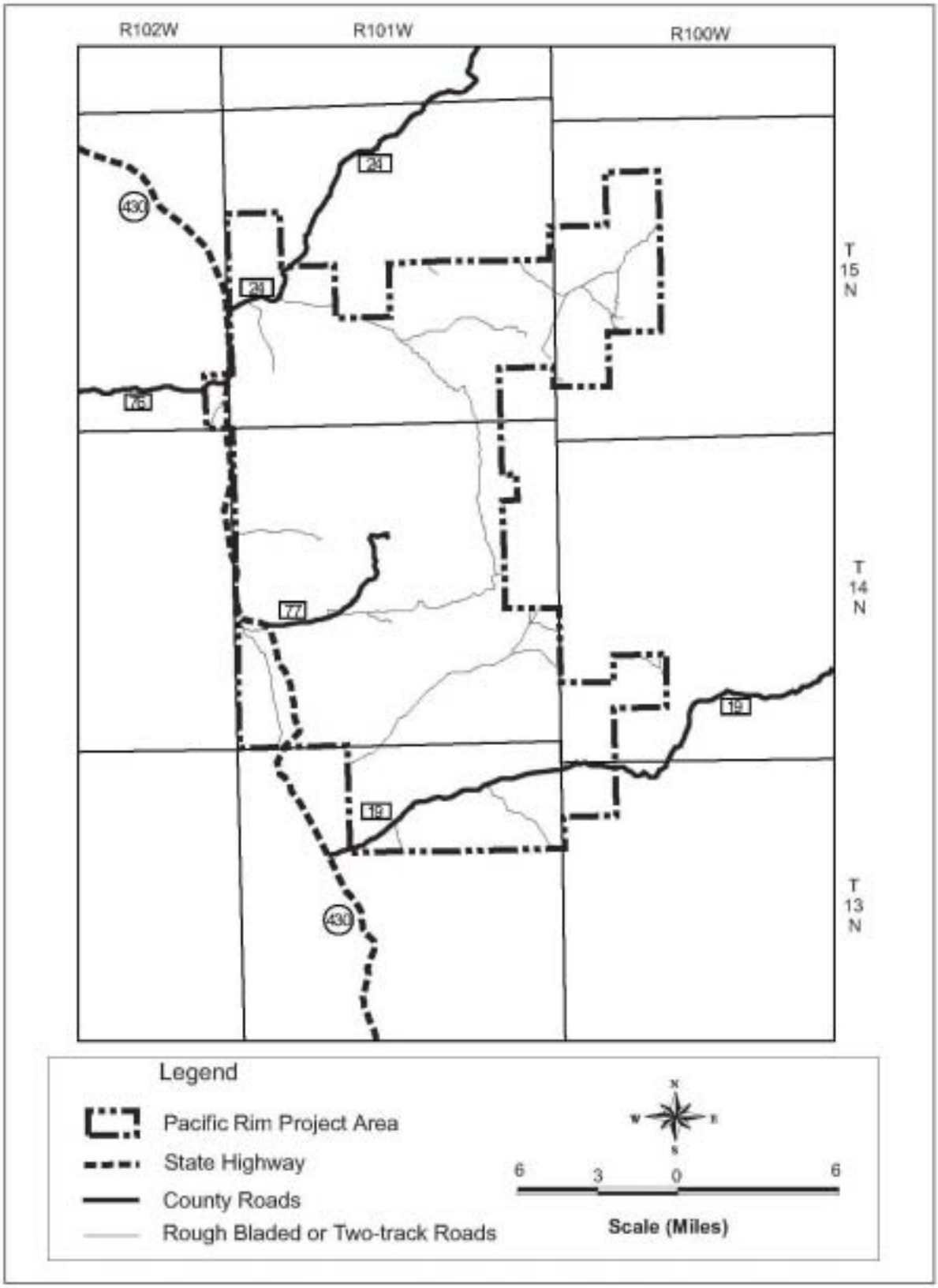


Figure 3-23. Transportation Network on the PRPA.

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the PRPA 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.

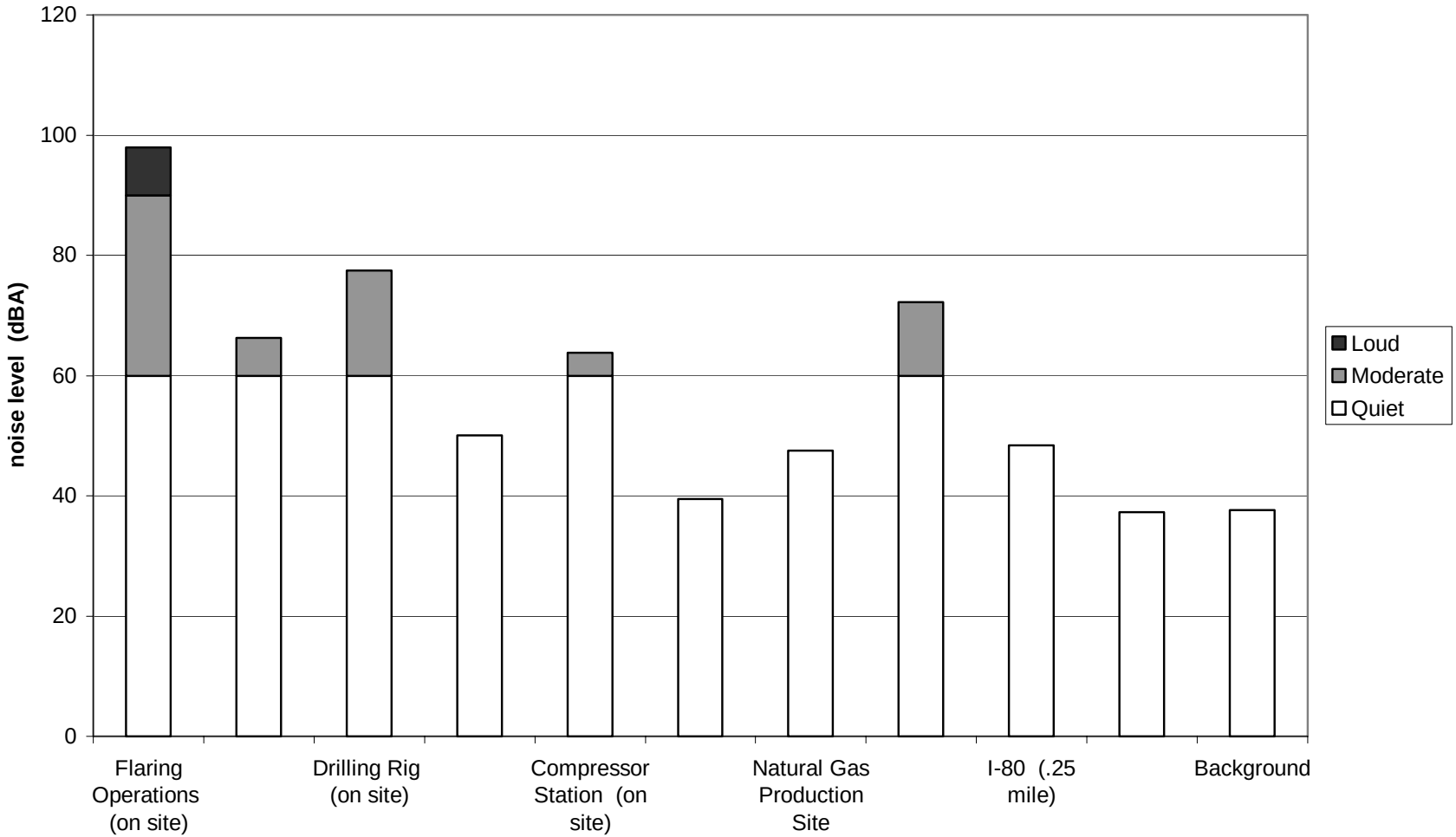
There are also existing low-level risks associated with natural gas pipelines, although these risks are statistically very small. Nationwide, injuries associated with gas transmission pipelines averaged 14 per year from 1990 through 1996, fatalities averaged one per year and incidents such as ruptures 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 USDI-BLM, OSHA, USDOT and Wyoming OGCC and OHSA each regulate certain safety aspects of oil and gas operations.

Currently within the PRPA there are risks associated with vehicular travel on improved and unimproved county, BLM and private 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 PRPA. Aircraft overflights (generally at high altitudes) and localized vehicular traffic on WYO 430 and county, BLM and two-track roads in the project area also create short-term, localized sound disturbances. For a comparison of typical noise values, refer to Figure 3-24.

Figure 3-24. Typical Noise Levels near Oil & Gas Operations



Data taken from Continental Divide EIS (BLM, 1999)

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 Pacific Rim 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

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, Warren would coordinate with private land owners to determine which measures would be applied, to what degree, and where. Also, because of the similarity between the Proposed Action and No Action, it is assumed that the mitigation described applies to both alternatives. 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.

CHAPTER 4: ANALYSIS OF ENVIRONMENTAL CONSEQUENCES

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 Direct and Indirect Impacts

4.1.1.1.1 Proposed Action

Impacts could occur to the geologic environment as a result of the Proposed Action. If alteration of existing land surface results in steepening slopes, increasing runoff, undercutting that could initiate slumping, landsliding, or other mass movements, or results in accelerating erosion of existing valley heads. Implementation of mitigation measures and procedures for soils and water resources described in Chapter 2 would make the probability of such impacts 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. No landslides or mass movement deposits are mapped within the PRPA and no known earthquake epicenters are recorded within the area.

4.1.1.1.2 No Action Alternative

Under the No Action Alternative approximate LOP surface disturbance on federal lands (25.8 acres) is less than that of the Proposed Action (153 acres). Although the magnitude of impacts could be greater for the Proposed Action, the types of potential impacts for the two alternatives are the same.

4.1.1.2 Mitigation

No additional mitigation to the geologic environment is proposed.

4.1.1.3 Residual Impacts

No residual impacts to the geologic environment are identified.

4.1.2 Minerals

4.1.2.1 Direct and Indirect Impacts

4.1.2.1.2 Proposed Action

Inventory of mineral resources in the PRPA revealed no major mineral resources that would be impacted by implementation of the Proposed Action and No Action Alternative other than natural gas resources reserves. Successful field development would result in natural gas resources production and depletion, if permitted by federal and state agencies, and therefore should not be considered an adverse impact. Shallow gas is the primary mineral resources that would be impacted. Production of these resources would generate public and private revenue.

Construction grade materials are likely to be used from local sources (in the PRPA and surrounding areas) for surfacing materials for oil and gas facilities. If development is extensive, known accumulations of local materials may become depleted and additional sources outside of, or within, the PRPA would need to be identified and used. The magnitude of impacts depends on the number of roads, well pads, and other facilities built under each alternative.

4.1.2.1.2 No Action Alternative

The approximate LOP surface disturbance on federal lands (25.8 acres) for the No Action Alternative is less than that of the Proposed Action (153 acres). Although the magnitude of impacts could be greater for the Proposed Action, the types of potential impacts are the same for both alternatives. However, under the methods prescribed in the No Action Alternative, the natural gas resources available utilizing current technologies may not be able to be extracted to their fullest extent.

4.1.2.2 Mitigation

No mitigation to the mineral environment is proposed. It is assumed that all drilling and completion activities as described in Chapter 2 will follow standard applicable requirements of the WOGCC and federal and local agencies.

4.1.2.3 Residual Impacts

Depletion of natural gas reserves is an unavoidable impact associated with implementation of the Proposed Action or the No Action Alternative.

4.1.3 Paleontology

4.1.3.1 Direct and Indirect Impacts

4.1.3.1.1 Proposed Action

Direct impacts to fossils would include damage or destruction of scientifically significant fossil resources during construction, with subsequent loss of information. Adverse indirect impacts would include fossil damage or destruction by accelerated erosion due to surface disturbance. In addition, improved access and increased visibility could result in unauthorized fossil collection or vandalism of fossil resources.

The Proposed Action could result in direct and indirect impacts to fossil resources caused by surface disturbance, particularly where disturbances will affect the Fort Union, Wasatch and Green River Formations. These formations are known contain or have a high potential to contain, fossils of scientific importance (BLM Paleontology Class 5).

The Fort Union, Wasatch, and Green River Formations which underlie the PRPA are ranked as Class 5 formations. According to the Probable Fossil Yield Classifications (PYCF) under development by the BLM Wyoming State Office (Hanson 2003, Blackburn 2004), class 5 formations include highly fossiliferous geologic units that regularly and predictably produce either vertebrate fossils or scientifically significant non-vertebrate fossils. Such formations are at risk of natural degradation, human-caused adverse impacts, or both, and require appropriate consideration during environmental evaluation of potential affects to paleontology of surface disturbing activities. No comprehensive surveys have been conducted for fossils in the PRPA, but it is likely that the Fort Union, Wasatch, and Green River Formations have unidentified fossil resources in them within the project boundaries. As a result, excavation in the Fort Union, Wasatch, and Green River Formations could reveal fossils of scientific significance that would otherwise have remained buried and unavailable for scientific study. Newly discovered fossils would be available for future scientific study as long as they are properly collected and catalogued into a museum repository along with associated geologic data. In this way significant positive consequences including the unanticipated discovery of previously unknown scientifically significant fossils, could result.

4.1.3.1.2 No Action Alternative

The approximate LOP surface disturbance on federal lands (25.8 acres) for the No Action Alternative is significantly lower than that of the Proposed Action (153 acres). Although the magnitude of impacts could be greater for the Proposed Action, the types of potential impacts are the same for the two alternatives.

4.1.3.2 Mitigation

The magnitude of potential impacts to fossil resources can be reduced by the implementation of paleontological resource mitigation measures described below.

Areas underlain by the Fort Union, Wasatch, and Green River Formations should be surveyed by a BLM-permitted paleontologist prior to construction disturbance and monitored during excavation, if such a recommendation is appropriate. If fossil resources are uncovered as a result of survey of lands slated for disturbance associated with the Proposed Action or No Action Alternative, the project proponent and authorized personnel should immediately notify the BLM for consideration for further action. If such fossil resources are discovered during surface disturbance, work should cease immediately in the area of the discovery until the fossil remains can be evaluated for scientific significance by a BLM-permitted paleontologist.

If fossil remains of significance are identified either during survey or during excavation then additional mitigation may be proposed as necessary. Additional mitigation could include collection, identification, and curation of the fossil remains and potentially monitoring of on-going surface disturbance in the area of discovery.

4.1.3.3 Residual Impacts

No residual impacts to fossil resources are identified.

4.2 AIR QUALITY

4.2.1 Direct and Indirect 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 generator engine and natural gas compressor engine 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 primary hazardous air pollutant (HAP) emitted from the Proposed Action sources. Emissions of benzene, toluene, ethylbenzene and xylenes (BTEX) compounds and n-hexane 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 an average development rate of 65 wells per year (60 gas wells and 5 injection wells) over a two-year period. A total of 120 gas wells would produce an estimated 48 MMscf/day of natural gas.

Table 4-1. Proposed Action Emission Summary

Pollutant	Emissions (tons/year)				Total Estimated Emissions (tons/year)
	Well Development	Well Production	Well Subtotal	Gas Compression and Dehydration	
NO_X	93.3	37.8	131.2	168.6	299.8
CO	24.6	39.4	64.1	56.4	120.5
VOC	6.9	37.8	44.7	113.6	158.3
SO_2	1.6	0.0	1.6	0.0	1.6
PM_{10}	86.1	0.0	86.1	0.2	86.2
$PM_{2.5}$	16.6	0.0	16.6	0.2	16.8
Formaldehyde	0.1	1.9	1.9	7.8	9.7

The individual sources of Proposed Action related emissions are discussed below. Detailed emission calculations for each activity are available in Appendix A-1.

Construction, Drilling, and Well Development Emissions

During the construction phase, vehicle and fugitive dust emissions would increase within the PRPA. 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.

Construction, drilling, and well development emissions are not anticipated to have substantial effects on air quality within the PRPA or the surrounding cumulative assessment area for the following reasons:

- Due to the limited scope (restricted to locations where construction is actively taking place), the adequate well spacing (160-acre), 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 10-20 year life of the Proposed Action. Construction activities and associated emissions from a well and its associated road and pipeline would not likely overlap in time and space with a nearby well.
- Pollution impacts from new road construction activities will be minimized through use of the existing improved road network, which represents 40% of proposed access roads. The unimproved BLM road network will also be used where appropriate, further reducing the need for new road construction.
- Results from significantly 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 (USDI-BLM 2002; USDI-BLM 2003) suggest that well development emissions will not have a substantial affect over the life of the Proposed Action.

Compressor and Generator Engines

Five natural gas compressor stations, each consisting of two 1,150 horsepower (hp) compressors and one dehydrator would be constructed and operated. For analysis purposes, it was assumed that Caterpillar 3516 TALE lean-burn compressor engines would be utilized at all proposed compressor locations. This engine type has been permitted by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ-AQD 2003) at an initial compressor site within the PRPA. The compressors represent the primary Proposed Action source of NO_X and CO emissions at 166.6 and 55.5 tons per year, respectively. The dehydrator burner emissions are inconsequential at two tons per year of NO_X and less than one ton per year of CO. The compressors and dehydrators would also emit lesser amounts of VOCs.

Each gas and injection well would require a pump powered by electricity during well development and to initiate and maintain production. Additionally, several transfer stations operating small centrifugal pumps to transport produced water from the gas well to the water injection well may also be needed. Temporary natural gas-fueled generators located within the central compressor stations are proposed to generate the electricity needed to operate these

pumps. Once permanent electrical distribution lines are constructed, electricity will be supplied from an electric utility substation or high voltage line. For analysis purposes, it was assumed that each gas and injection well, on average, would require a pump rated at 30 hp, for a total power requirement of 3,900 hp. Additionally, it was assumed that Caterpillar G3516 SITA rich-burn generator engines would be used at all proposed generator locations. This engine type has been permitted by the WDEQ-AQD (2003) at an initial central generator site within the PRPA. At emission rates of 1 gram per horsepower-hour, generator engines are estimated to account for 37.7 tons per year of both NO_X and CO emissions.

4.2.1.1.2 Criteria Pollutant Impacts

The latest version of the EPA-approved Industrial Source Complex Short-Term (ISCST3) dispersion model was applied with regulatory default options to predict maximum criteria pollutant and formaldehyde air quality impacts. Proposed Action sources included in the modeling analysis were compressor and generator engines located at five central stations. Five years of Rock Springs surface and corresponding Lander upper air meteorological data (1991-1995) provided by the WDEQ-AQD 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 2003a). 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 ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Maximum Proposed Action Impact Plus Background ($\mu g/m^3$)	National and Wyoming Ambient Air Quality Standard ($\mu g/m^3$)	Percent of NAAQS
NO_2 Annual	10.9	3.4[a]	14.3	100	14%
CO 1-hour	597.8	2,299[b]	2896.8	40,000	7%
CO 8-hour	126.3	1,148[b]	1274.3	10,000	13%

[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 ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Percent of Increment
NO_2 Annual	11	25	44%

4.2.1.1.3 Hazardous Air Pollutant Impacts

Hazardous air pollutant emissions were evaluated for short-term (acute), long-term (chronic), and carcinogenic effects by comparison to Environmental Protection Agency (EPA) recommended thresholds. 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 and generator engine sources.

To assess the potential chronic health effects of CH_2O in comparison to EPA guidelines, predicted annual 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.

In addition, the EPA has summarized a set of acute dose-response levels, used by different agencies for different purposes, for assessing potential short-term (e.g., on the order of 1-hour) HAP exposures (EPA 2003b). The most relevant for assessing acute exposures from routine releases of chemicals are Reference Exposure Levels (RELs), used by the California Environmental Protection Agency (CalEPA). The RELs are derived specifically to assess routine, short-term (1-hour) exposures to chemicals.

The use of RfCs and RELs for HAP evaluation represents a departure from past analyses. In previous NEPA studies, a range of state acceptable concentration levels were utilized as the significance criteria. The basis for the state acceptable concentration levels was the National Air Toxics Information Clearing House (NATICH) database, which is now considered outdated. The RfCs are derived from the most current scientific data. In addition, previous studies did not include an assessment of acute effects.

Tables 4-4 and 4-5 present the REL and RfC, respectively, for CH_2O. The predicted 1-hour concentration is compared to the listed REL and the predicted annual average concentration is compared to the listed chronic exposure RfC. As the results illustrate, predicted concentrations are below the thresholds, suggesting that no acute or chronic adverse health effects would be expected from the Proposed Action.

Table 4-4. Formaldehyde Acute Reference Exposure Level Comparison

Hazardous Air Pollutant	Maximum Predicted One-Hour Concentration ($\mu g/m^3$)	Acute Reference Exposure Level (REL) ($\mu g/m^3$)[a]	Percentage of REL
Formaldehyde	30.0	94	32%

[a] Source: EPA (2003b).

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).

Table 4-5. Formaldehyde Chronic Reference Concentration Comparison

Hazardous Air Pollutant	Maximum Predicted Annual Concentration ($\mu g/m^3$)	Reference Concentration (RfC) ($\mu g/m^3$)[a]	Percentage of RfC
Formaldehyde	0.7	9.8	7%

[a] Source: EPA (2002).

The analysis considered two exposure scenarios. The Maximum Exposure Scenario assumed that a person could be continuously exposed to the maximum concentration for the life of the project, which is 20 years. Considering the remoteness of the project and the absence of any nearby residences, a more realistic scenario, termed the Most Likely Exposure (MLE), was also evaluated. The Most Likely Exposure Scenario assumed a person would be exposed 40 hours per week, 50 weeks per year, for 20 years.

Table 4-6 presents the estimated incremental carcinogenic risks. Applying the predicted maximum annual formaldehyde concentration of 0.68 $\mu g/m^3$ and assuming a maximum exposure scenario of 24 hours per day for 20 years, the incremental formaldehyde cancer risk is estimated at 2.5 incidents per one million exposures. This estimated formaldehyde risk is slightly higher than the EPA significance criteria of 1.0 incidents per million exposures. This method of analysis, however, is extremely conservative based on the assumption that persons would be continuously 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.

Applying a more realistic occupational exposure scenario or MLE, the incremental risk is estimated at 0.6 incidents per million exposures, below the EPA significance criteria of 1.0 incident per million exposures.

Table 4-6. Potential Incremental Carcinogenic Risk

Hazardous Air Pollutant	Incremental Carcinogenic Risk Resulting from the Maximum Exposure Scenario	Incremental Carcinogenic Risk Resulting from the Most Likely Exposure Scenario
Formaldehyde	2.5 incidents in one million	0.6 incidents in one million

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 compressor and generator engines, wind erosion, drill rig, and vehicle dust and tailpipe emissions. Predicted results were evaluated against visibility, dry and wet nitrogen deposition, and acid neutralization capacity (ANC) criteria for the areas of special concern listed in Table 4-7.

Visibility Impacts

Potential 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 applied following the recommendations in the Federal Land Managers Air Quality Related Values Workgroup (FLAG) (2000) Guideline document. The pollutants responsible for potential 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 2003c) by calculating a potential change in deciview. Regional background particulate concentrations from the FLAG (2000) Phase I Report for Bridger Wilderness were applied for all areas of special concern listed in Table 4-7.

Table 4-7. Areas of Special Concern

Special Concern Area	PSD Classification	Distance[a] from Proposed Action (mi)	Direction from Proposed Action
Bridger Wilderness	Federal PSD Class I	125	NNW
Fitzpatrick Wilderness	Federal PSD Class I	145	NNW
Popo Agie Wilderness	Federal PSD Class II	145	NNW
Wind River Roadless	Federal PSD Class II	125	NNW
Savage Run Wilderness	State PSD Class I	120	E

[a] Distance from the center of the PRPA to the center of the area of concern.

For the Proposed Action alone, no impacts exceeding the 0.5 or 1.0 Δ dv LAC thresholds were predicted using FLAG (2000) data. Table 4-8 lists the predicted maximum impacts for each special concern area applying FLAG background extinction values. See Appendix A-2 for model results using Interagency Monitoring of PROtected Visual Environments (IMPROVE) background.

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) 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.

Incremental N fluxes resulting from Proposed Action emission sources were evaluated against both total-load and project-level deposition thresholds. Deposition Analysis Thresholds (DATs) were established jointly by the National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) to assess project-level deposition impacts at Class I areas. The DAT is the additional amount of deposition that triggers a management concern, not necessarily the amount that constitutes an adverse impact to the environment. Table 4-9 indicates that the maximum project-level N deposition predicted for each area of special concern is below the DAT of 0.005 kg ha^{-1} yr^{-1} for Western Class I areas (National Park Service 2003).

Predicted total N deposition (Proposed Action plus background) was compared to the USDA-Forest Service Bridger "level of concern" value of 3 kg ha^{-1} yr^{-1} (defined as the acceptable level of total deposition) and "red line" value of 10 kg ha^{-1} yr^{-1} (defined as the total deposition an area can tolerate) (Fox et al 1989). Table 4-10 indicates that Proposed Action impacts on total N deposition, in conjunction with the maximum annual background deposition recorded at Pinedale, WY between 1989-2000 (as recommended in the FLAG [2000] Phase I report), are predicted to be below these threshold values for all areas of special concern.

Table 4-8. Predicted Visibility Impacts From the Proposed Action

Special Concern Area	Maximum Visibility Impact, FLAG Background Data (Δ dv)	Visibility Significance Criteria (Δ dv)	Number of Days Greater than or equal to 0.5 Δ dv	Number of Days Greater than or equal to 1.0 Δ dv
Bridger Wilderness	0.38	0.5 / 1.0	0	0
Fitzpatrick Wilderness	0.37	0.5 / 1.0	0	0
Popo Agie Wilderness	0.47	0.5 / 1.0	0	0
Savage Run Wilderness	0.40	0.5 / 1.0	0	0
Wind River Roadless	0.42	0.5 / 1.0	0	0

Table 4-9. Proposed Action Incremental Nitrogen Deposition Impact

Special Concern Area	Nitrogen Deposition Analysis Threshold (DAT)[a] (kg ha^{-1} yr^{-1})	Maximum Proposed Action Nitrogen Deposition (kg ha^{-1} yr^{-1})	Maximum Percent of DAT
Bridger Wilderness	0.005	0.0012	24%
Fitzpatrick Wilderness	0.005	0.0008	16%
Popo Agie Wilderness	0.005	0.0012	24%
Savage Run Wilderness	0.005	0.0009	18%
Wind River Roadless	0.005	0.0009	18%

[a] Source: National Park Service (2003).

Acid Neutralization Capacity Impacts

An analysis of potential changes to Acid Neutralization Capacity (ANC) was performed for each of six sensitive lakes (Table 4-11) 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

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 4-10. Proposed Action Total Nitrogen Deposition Impact

Special Concern Area	Maximum Proposed Action Nitrogen Deposition (kg ha^{-1} yr^{-1})	Background Nitrogen Deposition (kg ha^{-1} yr^{-1})[a]	Total Nitrogen Deposition (kg ha^{-1} yr^{-1})	Total Percent of Bridger "Level of concern"[b]	Total Percent of Bridger "Red Line"[c]
Bridger Wilderness	0.0012	1.6	1.6	53%	16%
Fitzpatrick Wilderness	0.0008	1.6	1.6	53%	16%
Popo Agie Wilderness	0.0012	1.6	1.6	53%	16%
Savage Run Wilderness	0.0009	1.6	1.6	53%	16%
Wind River Roadless	0.0009	1.6	1.6	53%	16%

[a] Maximum annual N deposition measured at Pinedale between 1989-2000 (Source: Pinedale CASTNet and NADP).
[b] Bridger "level of concern" equal to 3 kg ha^{-1} yr^{-1} (Fox et al 1989).
[c] Bridger "red line" equal to 10 kg ha^{-1} yr^{-1} (Fox et al 1989).

Table 4-11. Proposed Action Acid Neutralization Capacity Impact

Lake Name	Special Concern Area	Background ANC Concentration [a] (µeq/l)	Level of Acceptable Change	Proposed Action Change in ANC
Black Joe	Bridger Wilderness	67.0	10%	0.02%
Deep	Bridger Wilderness	59.9	10%	0.02%
Hobbs	Bridger Wilderness	69.9	10%	0.01%
Upper Frozen	Bridger Wilderness	5.0	1 µeq/l	0.01 µeq/l
Ross	Fitzpatrick Wilderness	53.5	10%	0.01%
Lower Saddlebag	Popo Agie Wilderness	55.5	10%	0.02%

[a] Background ANC values compiled from 24 data files supplied by the USDA-FS (2003). Background levels represent 10% lowest ANC as measured at lake outlet.

4.2.1.3 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 Alternatives, 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

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

<u>NO_x Mitigation</u>

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.

4.2.3 Residual Impacts

Despite application of mitigation efforts, 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 NAAQS thresholds, PSD increments, or HAP thresholds. 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 Direct and Indirect Impacts

4.3.1.1 Proposed Action

Impacts resulting from drill pad, access road, facility site, and pipeline ROW construction could include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, loss of topsoil productivity, and increased susceptibility of the soil (and underlying bedrock) to wind and water erosion, undercutting, collapse or subsidence, or accelerated headward erosion. The magnitude of the potential impacts will ultimately vary proportionally with the number of wells ultimately drilled and the total amount of associated disturbance. Further information on impacts to soils from the implementation of the Proposed Action is described in section 4.4.1.1.1, Surface Water.

4.3.1.2 No Action Alternative

The approximate LOP surface disturbance on federal lands (25.8 acres) for the No Action Alternative is lower than that of the Proposed Action (153 acres). Although the magnitude of impacts would be greater for the Proposed Action than the No Action Alternative, the types of potential impacts are the same. Potential impacts to soils are similar for the Proposed Action

and No Action Alternative, because both alternatives involve the drilling of oil and gas wells and building of supporting infrastructure.

4.3.2 Mitigation

No 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 Direct and Indirect 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 498 acres (approximately 1.0 percent of the total PRPA which encompasses about 47,598 acres). This total would include 149 acres of new surface disturbance from well locations (including on-site gathering, measurement, and compressor facilities), 144 acres of new roads or upgrades of existing roads, and 205 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 PRPA are WYO 430, SCR 19, SCR 24, and SCR 76. The existing road network was developed to access prior drilling, ongoing drilling, and production activities, as well as other land use activities on Federal surface. All new access

roads would be constructed in accordance with WSO BLM Manual 9113 Supplement. This is to minimize soil erosion due to road construction and use, thereby minimizing impacts to surface water from these actions. There will be no authorized use of unimproved roads to access wells or other facilities. The Proposed Action assumes the construction of no more than 120 wells and associated roads and pipelines. Roads will be designed to minimize disturbance, and all surface disturbance will 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 PRPA would have a maximum of 35.64 miles (129.6 acres) of new roads or upgrades of existing roads with a 30-foot wide average disturbance, and 35.64 miles (129.6 acres) of new gas and water collection lines would be installed in a 30-foot wide facilities corridor. An average of 0.33 mile of new or upgraded roads and 0.33 mile of new gas gathering and water discharge lines per well would be constructed and installed.

The majority of soil disturbance would be well away from stream channels as required by GRRMP management directives. 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 drainage channels identified on Figure 3-8 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/RPW 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, all drainage channels in the project area are ephemeral. 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. At least two feet of freeboard on all reserve pits would be maintained to ensure the pits are not in danger of overflowing. If leakage is found outside the pit, drilling operations would be shut down until the problem is corrected.

Water for use in drilling the wells would be obtained from properly permitted sources near the project area, from wells previously drilled in the project area, or from Rock Springs, Wyoming. The project would require approximately 4,500 barrels 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. For conservation purposes, water used to drill one well may also be used for drilling subsequent wells.

The method used for the disposal of produced water (water produced in association with the shallow gas, which is separated out at the well location) would be accomplished by disposal in one or more injection wells. Subsurface injection of produced water, as opposed to surface discharge, would protect surface water quality by reducing impacts such as increased soil erosion, degradation of surface water quality, and decreased permeability of surface soils that may occur if produced water is discharged in surface ponds or ephemeral drainages. The operator would obtain the permits 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, 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 were 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 to not cause accelerated erosion.

If drilling is productive and a well is completed for production, site erosion and off-site sedimentation would be controlled by promptly revegetating surface disturbance 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 Pacific Rim 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 areal 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 the 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 areal extent, and lies horizontally. Obviously, these simplifying assumptions are not met by the Almond Formation coal seams in the Proposed Action area; however, 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 long-term, steady-state discharge rate of five gpm was assigned to each of the 120 shallow gas well locations to simulate the Proposed Action. The locations of these 120 pumping wells were distributed in the locations proposed in the Pacific

Rim Unit Field Map. In order to present a conservative estimate, the model simulated these 120 wells pumping five gpm continuously for a period of 20 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 will decline over time, likely reaching zero in the later stages of the project. This is because as the formation pressures drop, the gas will begin to flow more freely into the well and much less water will need to be produced.

This model predicts that, after 20 years the 10-foot drawdown contour in the coal will extend approximately 11 miles north, 12 miles east, and 10 miles south of the PRPA. Ten feet of drawdown represents less than one percent of the estimated available head in this area. Water levels in the Almond Formation coal seam aquifer are predicted to decline as much as 2,000 feet within the PRPA (Figure 4-1)

Due to the approximate nature of the Theis aquifer model, drawdowns predicted between the PRPA 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) could be applied.

The reduction of hydraulic pressure head in the affected coal seam aquifer would mean that the probability is high that any well completed in the same Almond Formation coal seam within the area of influence (the projected 10 foot drawdown contour) may 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 PRPA, 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 will also be affected. At this time, little data are available to describe the geologic unit(s) that will be the injection target. Depths of the disposal wells are expected to range from 3,000 to 7,500 feet. 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 will 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 will 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 likely 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 groundwater would be fresher and have smaller concentrations of dissolved solids relative to that of an aquifer occurring at greater depth that would be targeted for disposal.

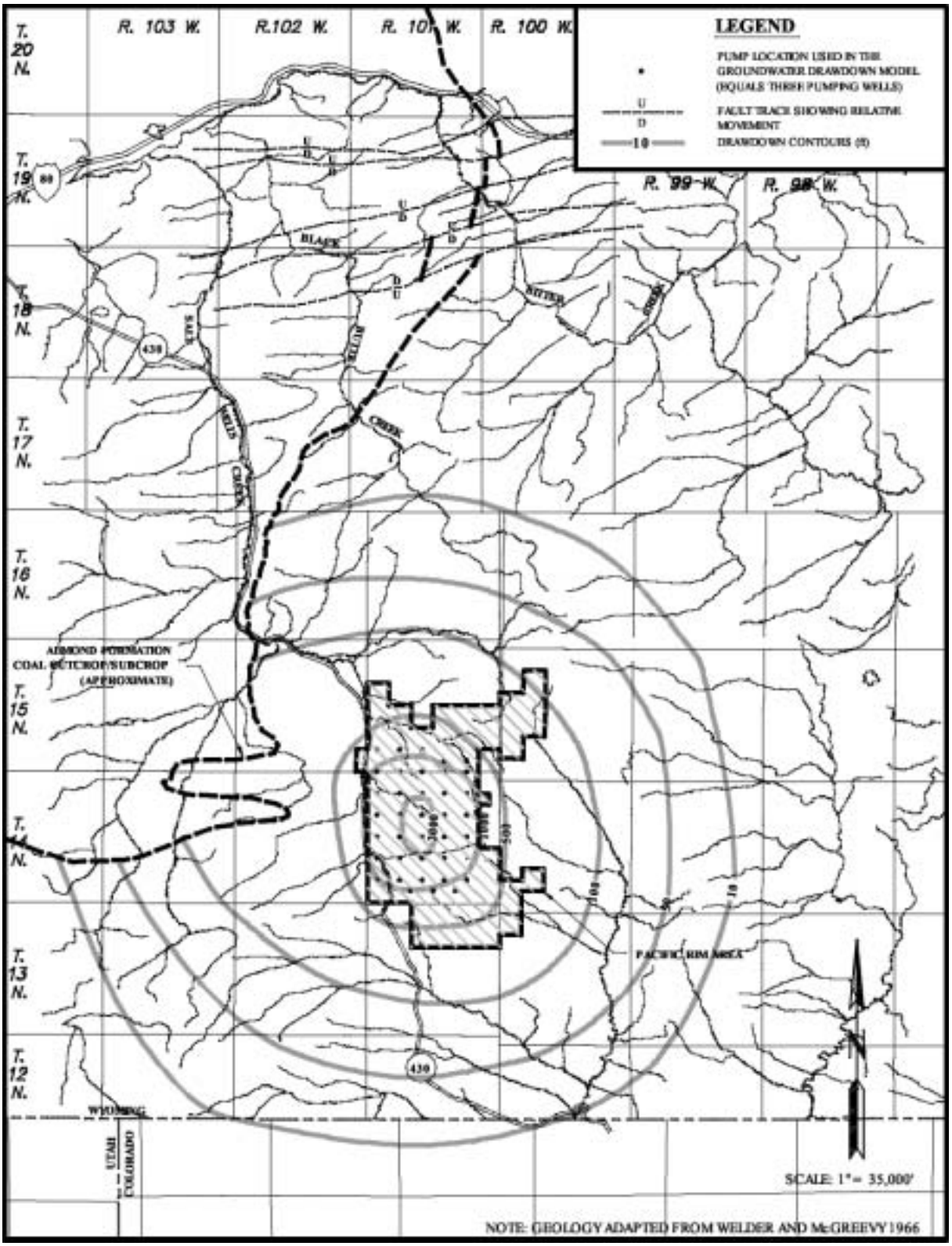


Figure 4-1. Modeled Maximum Extent of Drawdown Within the Almond Formation Coal Aquifer Due to the Proposed Action.

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, would 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 the No Action Alternative would be similar to the Proposed Action, but have a much lesser magnitude.

4.4.2 Mitigation

Warren proposes to implement mitigation measures, procedures, and management requirements on public lands administered by the BLM to avoid or mitigate resource or other land use impacts. These measures would be applied on privately owned surface and State of Wyoming lands unless otherwise specified by the involved private and/or State surface owners. 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.

The following measure would further reduce potential impacts resulting from the Proposed Action: Should any existing permitted groundwater rights (water wells) be adversely affected by the Proposed Action, Warren should rework, replace, or otherwise compensate the owner/permittee.

4.4.3 Residual Impacts

No adverse residual impacts would result from project implementation.

4.5 VEGETATION, WETLANDS AND NOXIOUS WEEDS

4.5.1 Direct and Indirect Impacts

4.5.1.1 Proposed Action

The Proposed Action assumes construction of 120 shallow gas wells and associated roads and pipelines. Construction and installation of well sites, access roads, and ancillary facilities

(compressor's, pipelines, etc.) would directly reduce the extent of vegetation cover types. Over the estimated 1 to 3 year development phase, the Proposed Action would initially disturb an estimated 497.5 surface acres (Table 2-1), which represents about 1.2% of the total land surface of the project area (43,159.6 acres). During the projected 10 to 20 year life-of-project (LOP), the initial 497.5 disturbed acres would gradually decrease to about 153.0 acres dependent upon time required for successful reclamation. The estimated LOP acreage represents about 0.4% of the total land surface of the project area. As stated in Section 2.0, if initial drilling attempts are unsuccessful or uneconomical, the possibility exists that Warren would abandon the proposal.

Analysis of construction disturbance upon primary vegetation cover types is based on the approximate location of proposed wells prior to construction; actual placement of wells may change as drilling proceeds and reservoir characteristics are determined. For purposes of this analysis it was assumed that surface disturbance associated with the Proposed Action would occur in proportion to the area of each vegetation type within the project area. Four vegetation types cover less than 200 acres of the PRPA and it is unlikely that any wells would occur in those vegetation types (Table 4-12). Disturbance of those vegetation types would primarily be related to roads and pipeline construction. Based on these assumptions, an estimated 80 wells would be located in the Wyoming big sagebrush primary cover type with a total disturbance of 329.4 acres or about 1.2% of this primary cover type (Table 4-12). This amount would decrease to about 100.7 acres for the LOP, or 0.4% of the Wyoming big sagebrush vegetation cover type in the PRPA (Table 4-12). The remaining 40 wells would be located in the saltbush fans and flats, Vasey big sagebrush, desert shrub, Utah juniper, Basin big sagebrush, birdsfoot sagebrush, and greasewood fans and flats vegetation cover types; see Table 4-12 for disturbance estimates in each vegetation type. No more than 1.2% of any vegetation type is expected to be disturbed during initial development and no more than 0.4% over the LOP.

In general, the extent of impacts upon vegetation will 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 would be achieved as discussed in Section 2.2.10 and 2.2.10.1.

Table 4-12. Estimated disturbance of vegetation cover types (acres) on the Pacific Rim Project Area – Proposed Action.

				Disturbance - Initial		Disturbance - LOP	
	Acres	% of PRPA	Est. # Wells	Acres	% of Type	Acres	% of Type
Wyoming big sagebrush	28633.2	66.3%	80	329.4	1.2%	100.7	0.4%
Saltbush fans and flats	3900.0	9.0%	11	45.8	1.2%	14.4	0.4%
Vasey big sagebrush	3013.1	7.0%	8	35.3	1.2%	11.5	0.4%
Desert shrub	2751.9	6.4%	8	32.3	1.2%	9.9	0.4%
Utah juniper	2323.3	5.4%	7	27.7	1.2%	8.5	0.4%
Basin big sagebrush	1251.1	2.9%	4	14.5	1.2%	4.1	0.3%

Birdsfoot sagebrush	535.6	1.2%	1	5.4	1.0%	1.6	0.3%
Greasewood fans and flats	361.5	0.8%	1	4	1.1%	1.2	0.3%
True mountain mahogany	164.8	0.4%	0	1.3	0.8%	0.5	0.3%
Black sagebrush	125.9	0.3%	0	1	0.8%	0.3	0.2%
Desert shrub/limber pine	90.6	0.2%	0	0.7	0.8%	0.3	0.3%
Shadscale	8.5	0.0%	0	0.1	1.2%	0	0.0%
Totals	43159.5	100%	120	497.5		153.0	

Disturbance of the primary vegetation cover types within the PRPA would not be significant because of the small percentage of disturbance within the PRPA and their abundance and wide area of distribution in this area of southwestern Wyoming. Despite the difficulty of establishing vegetation in upland 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 will be minimized assuming construction, maintenance, and operation of well pad sites and associated disturbances are in accordance with Chapter 2 of this EA, APD stipulations, and RMP requirements.

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, compressional/shear damage to biological soil crusts, and increased potential for invasive plant establishment.

Indirect impacts to the vegetation resource would be minor with implementation and compliance of, mitigation measures and stipulations stated in Chapter 2 of this EA, Warren'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.

4.5.1.1.1 Wetlands

Due to a paucity of wetland/riparian sites on the PRPA, 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 will be avoided. Permits under Section 404 of the Clean Water Act would be required for any activities in wetlands or waters of the United States. Warren would be required to demonstrate to the 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 PRPA and identified mitigation procedures as stated in Chapter 2 (Sections 2.2.11.2.5-6-7 & 8), Warren's APD stipulations, the RMP, COE and BLM surface-disturbing guidelines.

4.5.1.1.2 Biological Soil Crusts

Surface disturbing activities have the potential to negatively impact biological soil crusts if they are present. Potential impact of a disturbance to crustal organisms is affected by its type, severity, size, frequency, duration, and timing (Belnap et al. 2001). Compressional/shear disturbance to biological soil crusts would most likely occur due to off-road vehicle use and trampling (such as from vehicles and trampling by humans and animals). Loss of biological soil

crusts by burying is inevitable with road construction, trenching, and other operations that remove vegetation and topsoil.

Impacts to biological soil crusts can be minimized by limiting off-road vehicle activity (especially heavy construction equipment, trucks, pickup, and cars). Vehicle tracks often channel water off-site resulting in slowing or preventing their recovery and increasing erosion potential. Vehicles (e.g. all-terrain vehicles or ATVs) with high-flotation tire exert less force to the soil surface but may disrupt crusts by rapid turns which shear the topsoil.

4.5.1.1.3 Noxious Plant Species

Surface disturbing activities could increase the potential for infestation and spread of invasive plant species. Invasive weed species usually thrive on newly disturbed surfaces such as road and pipeline ROWs and out-compete the more desirable native plant species. As explained in Section 2.2.11.2.1, Warren 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 will 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 authorized in the *FEIS, Vegetation treatment on BLM lands in the thirteen western states* (USDI-BLM 1991).

4.5.1.2 No Action Alternative

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 PRPA under APDs approved by the WOGCC. Transport of natural gas products would be allowed from those wells in the PRPA that are in current production.

The No Action Alternative assumes construction of 12 wells with associated roads and pipelines. Construction and installation of well sites, access roads, pipelines, and ancillary facilities would directly reduce the extent of these vegetation cover types. Over the estimated 1 to 3 year development phase of the project, the No Action Alternative would involve a total initial disturbance of about 73.3 acres; the majority of this disturbance would likely occur in the Wyoming big sagebrush cover type. During the LOP and with successful reclamation, this total would decrease to about 25.8 acres.

Potential impacts to wetlands and waters of the U.S., biological soil crusts, and invasive plants would be similar to those described under the Proposed Action, but of a much lesser magnitude.

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.

4.6 RANGELAND RESOURCES

4.6.1 Direct and Indirect Impacts

4.6.1.1 Proposed Action

Under the Proposed Action, an estimated 497.5 total (federal, state, private) acres will initially be disturbed which represents about 0.03% of the total land area (1,946,321 acres) of the Rock Springs and Vermillion Creek grazing allotments. During the LOP, this total is estimated to decrease to about 153.0 acres which represents about 0.008% of the total land area of the two allotments.

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 4-13 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.

Table 4-13. Estimated Reduction of Animal Unit Months in the Rock Springs (No. 13018) and Vermillion Creek (No. 04003) Grazing Allotments due to Land Surface/Vegetation Disturbance for the Proposed Action and No Action Alternatives.

PROPOSED ACTION[1]				
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**
Federal	455.5	43.4	138.1	13.2
State	14.0	1.3	4.7	0.5
Private	28.0	2.7	9.3	0.9
TOTAL	**497.5**	**47.4**	**153.0**	**14.6**
NO ACTION ALTERNATIVE[2]				
Federal	29.5	2.8	10.4	1.0
State	14.0	1.3	4.7	0.5
Private	29.8	2.8	10.7	1.0
TOTAL	**73.3**	**6.9**	**25.8**	**2.5**

1 See Table 2-1 for individual gas field component acreage for the Proposed Action.
2 See Table 2-4 for individual gas field component acreage for the No Action Alternative.

Assuming all 120 wells are successful, the Proposed Action would result in an estimated initial 497.5 acres of short-term disturbance (about 1.2% of the total project area) or about 0.03% of the 1,946,321 acres encompassed within the Rock Springs and Vermillion Creek grazing allotments (Lloyd 2004). During the anticipated LOP, this total is estimated to decrease to about 153.0 acres (0.4% of the total project area) or about 0.008% of the total land area of the two grazing allotments.

For purposes of this analysis, a stocking rate of 10.5 acres/AUM is used. This figure was determined by averaging the current stocking rate for the Rock Springs grazing allotment (10 acres/AUM) and the stocking rate for the Vermillion Creek grazing allotment (11 acres/AUM)(see Table 3-15). Based on this stocking rate, the Proposed Action would result in a short-term loss of about 47.4 AUMs, and a LOP loss of about 14.6 AUMs. These amounts are substantially less than one percent of the permitted 193,780 AUMs for the combined Rock Springs and Vermillion Creek allotments (Lloyd 2004).

Successful reclaimed sites produce at a rate of about 6 acres per AUM (USDI-BLM 1999b), which is almost twice the present 10.5 acres per AUM stocking rate used in this analysis. 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. 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 would increases the potential for livestock/vehicle collisions. However, if Warren advises project personnel regarding appropriate speed limits on designated access roads as specified in Chapter 2 of this EA, and these instructions are complied with, the likelihood of livestock/vehicle collisions would be minimized.

Direct and indirect impacts to the grazing resource are anticipated to be minor and short-term. The primary direct impact to the grazing resource would be a short-term loss of available forage as a result of construction and production-related disturbance. Indirect impacts of the proposed project on grazing resources may result from increased human and vehicle activity that may increase the potential for livestock/vehicle collisions. However, if Warren advises project personnel regarding appropriate speed limits on designated access roads as specified in Chapter 2, and these instructions are complied with, the likelihood of livestock/vehicle collisions would be minimized.

Sheep and cattle grazing would continue throughout the duration of the project. Warren could coordinate with affected livestock operators to minimize disruption during livestock operations, including calving and lambing. All gates should be closed after opening. If fences are breached due to operations they would be repaired as quickly as possible.

Implementation/compliance of mitigation measures and stipulations stated in Chapter 2 of this EA, Warren's APDs, and the RMP, would minimize potential direct and indirect impacts to the grazing resource.

4.6.1.2 No Action Alternative

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 PRPA under APDs approved by the WOGCC.

Under the No Action Alternative, an estimated 73.3 acres (Proposed Action = 497.5 acres) would be initially disturbed due to continuing gas-related activity which represents about 0.2% of the PRPA land surface area and about 0.004% of the total land area of the Rock Springs and Vermillion Creek grazing allotments. As site reclamation proceeds, the estimated LOP disturbance acres would be reduced from 73.3 acres to 25.8 acres which represents about 0.06% o0f the PRPA and 0.001% of the total land area of the Rock Springs and Vermillion Creek grazing allotments (Table 4-13).

Under the No Action Alternative, the estimated reduction of initial AUMs would be about 6.9 AUMs which represents about 0.004% of the total permitted AUMs for the Rock Springs and Vermillion Creek grazing allotments. The estimated LOP reduction in total AUMs would stabilize at about 2.5 AUMs or about 0.001% of the total permitted AUMs for both allotments (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.

4.7 WILDLIFE

4.7.1 Direct and Indirect Impacts

4.7.1.1 Proposed Action

Over the proposed 1 to 3 year drilling period, approximately 120 shallow gas wells would be drilled, with 108 of those wells occurring on federal land. The development would initially disturb approximately 497.5 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. The exact locations of proposed development sites are not known; therefore, for the following impact analysis, it was assumed that placement of wells and other project facilities would occur evenly across the project area.

During the production phase, the unused portion of well sites and roads, as well as pipelines (a total of 344.5 acres) would be reclaimed, reducing the life-of-project disturbance to approximately 153 acres. Following completion of production operations (life of the project is estimated at 10-20 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 would 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 497.5 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 during the parturition period and 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 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 17.7% of the project area is classified as mule deer crucial winter/yearlong range and 82.3% of the project area is classified as mule deer winter yearlong range. An estimated 21 wells would be located in mule deer crucial winter/yearlong range; total disturbance associated with these wells would be approximately 87.6 acres (Table 4-14), or 1.1% of the crucial winter/yearlong range in the project area. Following reclamation, approximately 27.1 acres of crucial winter/yearlong range

would remain disturbed for the remaining life of the project. An estimated 99 wells would be located in winter yearlong range, disturbing a total of 409.9 acres, or 1.2% of the winter yearlong range in the project area. Following reclamation, approximately 125.9 acres of winter yearlong range would remain disturbed for the remaining life of the project.

During winter, mule deer primarily utilize shrubs including sagebrush, mountain mahogany, and antelope bitterbrush (DeBolt 2000). Mountain mahogany is also 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 significant impacts to mule deer in the area are expected because a very small percent (0.03%) of the crucial winter/yearlong range within the South Rock Springs Herd Unit would be disturbed and similar habitats are available in the surrounding area.

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 eventually eliminate disturbance to mule deer wintering on the project area. This closure would also limit the potential for poaching and/or harassment of mule deer.

No significant 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. These measures include using species for reclamation that are native and that provide quality forage for big game.

Elk. Nearly all of the project area is classified as elk yearlong range (94.9%). The remainder of the project area (5.1%) is not classified as any type of elk seasonal range. An estimated 114 wells would be located in elk yearlong range; total disturbance associated with these wells would be approximately 472.2 acres (Table 4-14), or 1.2% of the yearlong range in the project area. Following reclamation, approximately 145.1 acres of elk yearlong range would remain disturbed for the remaining life of the project. The remainder of the disturbance from the proposed action would be located in areas not designated as any type of elk seasonal range. 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). Impacts upon elk habitat are expected to be minor because no crucial winter range would be disturbed and only 1.2% of the yearlong range in the project area would be disturbed in the short-term. Overall, no significant adverse impacts upon the elk population utilizing the project area are expected provided that mitigation measures contained in this document and the RMP are implemented. These measures include using species for reclamation that are native and that provide quality forage for big game.

Pronghorn. The project area supports pronghorn throughout the year. Approximately 84.5% of the project area is classified as winter yearlong pronghorn range, and approximately 15.5% of the project area is classified as crucial winter/yearlong pronghorn range. An estimated 101 wells would be located in winter yearlong pronghorn range; total disturbance associated with these wells would be approximately 418.2 acres (Table 4-14), or 1.1% of the winter yearlong pronghorn range in the project area. Following reclamation, approximately 128.2 acres of winter yearlong pronghorn range would remain disturbed for the remaining life of the project. An

estimated 19 wells would be located in crucial winter/yearlong pronghorn range; total disturbance associated with these wells would be approximately 79.3 acres, or 1.2% of the crucial winter/yearlong pronghorn range in the project area. Following reclamation, approximately 24.8 acres of crucial winter/yearlong pronghorn range would remain disturbed for the remaining life of the project.

Pronghorn crucial winter/yearlong range is located in the southern and extreme western portions 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 expected to be a minor impact because of the temporary nature of the displacement and the availability of comparable habitats in adjacent areas.

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 pronghorn crucial winter/yearlong range would reduce disturbance to pronghorn wintering on the project area. This closure would also limit the potential for poaching and/or harassment of pronghorn. No significant adverse impacts upon the pronghorn population utilizing the project area are expected provided that mitigation measures contained in this document and the RMP are implemented. These measures include using species for reclamation that are native and that provide quality forage for big game.

Big Game Summary. Overall, the entire project area is used year-round by at least three (3) big game species (antelope, mule deer, or elk). Significant impacts to populations of big game utilizing the PRPA are not expected with development of the Proposed Action. The southern portion of the project area provides crucial habitat for antelope, while the southwestern and extreme northeastern portions of the project area provide crucial habitat for mule deer. A small area in the southwestern portion of the project area (662 acres) includes both mule deer and pronghorn crucial winter/yearlong range (Figure 3-14). It is estimated that 1 or 2 wells may occur within this area of crucial big game overlapping habitat, resulting in disturbance of 3.5 - 7 acres of habitat (0.5% - 1%).

Table 4-14. Summary of impacts (acres) on big game seasonal ranges with construction of the Proposed Action.

Species Range Type	Area (ac)	Well Pads		Disposal Wells (ac)	Roads (ac)	Pipelines		Compressor (ac)	Total (ac)	%[1]
		#	ac			Gathering (ac)	Delivery (ac)			
Mule Deer										
Crucial Winter Yearlong	7,648	21	23.1	2.5	25.2	25.2	10.7	0.9	87.6	1.1
Winter Yearlong	35,512	99	108.9	9.9	118.8	118.8	49.9	3.6	409.9	1.2
Totals	43,160	120	132	12.4	144	144	60.6	4.5	497.5	1.2
Elk										

Yearlong	40,944	114	125.4	11.2	136.8	136.8	57.5	4.5	472.2	1.2
Out	1,834	6	6.6	1.2	7.2	7.2	3.1	0	25.3	1.4
Totals	43,160	120	132	12.4	144	144	60.6	4.5	497.5	1.2
Pronghorn										
Winter Yearlong	36,455	101	111.1	9.9	121.2	121.2	51.2	3.6	418.2	1.1
Crucial Winter/Yearlong	6,705	19	20.9	2.5	22.8	22.8	9.4	0.9	79.3	1.2
Totals	43,160	120	132	12.4	144	144	60.6	4.5	497.5	1.2

1 - Percentage of each type disturbed

4.7.1.1.3 Wild Horses

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.

All gates will be closed each time after opening. If fences are breached they would need to be repaired as quickly as possible.

The impact of project-related activities on forage production is shown in Table 4-13. The Proposed Action is estimated to initially reduce available Animal Unit Months (AUM's) by about 47.4 AUM's which represents about 0.02% of the total 193,780 AUM's permitted for the Rock Springs and Vermillion Creek grazing allotments (Lloyd 2004). During the estimated LOP, this total is estimated to decrease to about 14.6 AUM's which represents about 0.008% of the total permitted AUM's for the two allotments. The short-term impacts of vegetation disturbance and/or removal of wild horses due to project activities is anticipated to be minor because the maximum initial disturbed acreage (497.5 acres, Table 2-1) represents only 0.03 % of the total 1,946,321 acres within the Rock Springs and Vermillion Creek grazing allotments.

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

Risk of displacement of wild horses from the PRPA to areas outside the HMA boundary is believed to be minimal due, in large part, to:

(1) Warren estimates that 1-3 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, and;

(2) Free-roaming wild horses in the Salt Wells HMA have demonstrated the innate capacity to disperse over wide areas in search of food and water, seek shelter, or to escape insect pests and human activity.

Primary public access to view wild horses on and near the project area is via WYO 430, Sweetwater County Road's 19, 4-24 and 4-26, and numerous access roads already present in the PRPA. The Proposed Action would not affect the opportunity for the public to view wild horses.

Indirect impacts of the proposed project on wild horses may result from increased human and vehicle activity that may increase the potential for horse/vehicle collisions. However, if Warren advises project personnel regarding appropriate speed limits on designated access roads as specified in Chapter 2, and these instructions are complied with, the likelihood of horse/vehicle collisions would be minimized. The wary nature of wild horses also decreases their likelihood of being struck by a vehicle. In addition, the wild horse population in the Salt Wells HMA is habituated with local vehicle traffic on the primary roads of the PRPA.

4.7.1.1.4 Upland Game Birds

Greater Sage Grouse. See Section 4.8.2.1.2.

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 0.1% of the state's total harvest of mourning doves occurred in 2002 (WGFD 2003c). Mourning dove habitat on the project area is marginal in quality and disturbances that may occur are not expected to significantly 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 significant 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 active raptor nests. 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 may be considered active if they were used within the past three years. Records from the BLM Rock Springs Field Office and HWA show that 23 raptor nests occur on or within one mile of the PRPA (Figure 3-15). Activity status of raptor nests will be checked prior to well development. If new raptor nest sites are located on the project area in future years,

appropriate avoidance and mitigation measures would be taken to avoid significant impacts to breeding raptors.

4.7.1.2 No Action Alternative

Impacts resulting from the implementation of this alternative would be similar to those described under the Proposed Action, but of a lesser magnitude. It is estimated that approximately 73.3 acres of general wildlife habitat would be disturbed under the No Action Alternative (see discussion in Section 2.3).

4.7.2 Mitigation

No additional mitigation is required.

4.7.3 Residual Impacts

Although the potential impacts associated with the Proposed Action would not be substantial, the effects of some would persist until they were off-set over time. Such effects would include the: (1) long-term loss of 27.1 and 24.8 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.

4.8 SPECIAL STATUS WILDLIFE, FISH AND PLANT SPECIES

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

4.8.1.1 Proposed Action

The following species are either threatened, endangered, or proposed for listing under the ESA. These species may have potential to occur on or near the project area and therefore potential impacts to these species caused by the Proposed Action are considered.

4.8.1.1.1 Mammals

Black-footed Ferret. In Wyoming, white-tailed prairie dog colonies provide essential habitat for black-footed ferrets. Ferrets depend almost exclusively on prairie dogs for food, and they depend upon prairie dog burrows for shelter, parturition, and raising young (Hillman and Clark 1980). Prairie dog towns within the PRPA were mapped during the fall of 2003. Eighteen colonies, covering 3,612 acres, were surveyed for the presence of black-footed ferrets in September and October 2003 (HWA 2003a, b). All black-footed ferret surveys were performed in accordance with black-footed ferret survey guidelines outlined by the FWS (USDI-FWS 1989). No black-footed ferrets or their signs were observed during the nocturnal spotlight survey or morning ground search (HWA 2003a,b). Survey results and maps are available at the BLM RSFO.

On February 2, 2004, the U.S. Fish and Wildlife Service issued a notice that a block clearance, eliminating the need to conduct surveys for black-footed ferret surveys, was issued on many

areas in Wyoming (USDI-FWS 2004). According to the notice, ferret surveys in those areas are no longer required and the take of individual ferrets and effects to wild populations are not expected to be an issue. However, this does not mean that those areas included in the block clearance are free of all value to black-footed ferrets. The PRPA is located within the area that has been cleared from the need for ferret surveys. Therefore, no further black-footed ferret surveys would be required within the PRPA. Where possible, project developments should avoid white-tailed prairie dog colonies, however disturbance of colonies would not impact black-footed ferrets. It is estimated that 37.3 acres of white-tailed prairie dog colonies would be disturbed under the Proposed Action. This constitutes only 1.1% of the white-tailed prairie dog colonies within the PRPA. This amount of disturbance to prairie dog colonies would be a minor impact and would not result in significant effects upon the value of the colonies as potential future reintroduction sites. No impacts to black-footed ferrets would occur provided avoidance and mitigation measures outlined in this document and the RMP are implemented.

4.8.1.1.2 Birds

Bald Eagle. Bald eagles typically build stick nests in the tops of large coniferous or deciduous trees along streams, rivers or lakes. This type of habitat is not present on the project area, therefore, bald eagles are not expected to nest there. Bald eagles may utilize the project area during winter months when big game species are more concentrated on winter ranges. However, the area does not support concentrated use by bald eagles and bald eagle use of the project area is likely incidental. Therefore, the Proposed Action is not expected to impact bald eagles. No effect.

Yellow-billed Cuckoo. Due to the lack of adequate habitat on the project area and the fact that no records of yellow-billed cuckoo are documented within six miles of the project area (WGFD 2003a, WYNDD 2003) it is unlikely that the yellow-billed cuckoo occurs on the project area. No adverse impacts to this species are expected from implementation of the Proposed Action.

4.8.1.1.3 Fish

The drainages in the project area are ephemeral or intermittent. Four federally endangered fish species may occur as downstream residents of the Colorado River system: bonytail chub (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*). 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 are likely to be found within the project area, nor has critical habitat been established in Wyoming for any of these species (Upper Colorado River Endangered Fish Recovery Program 2002). Produced water would be injected into water disposal wells, therefore, produced water is not expected to have any impacts upon the endangered species found downstream from the PRPA.

The primary concern with the Proposed Action related to Colorado River endangered fish is water depletion. It is estimated that 4,500 barrels of water would be needed to drill and complete each well; however, actual water volumes would be dependent upon the depth of the wells and any losses that might occur during the drilling and completion operations. For conservation purposes, water used to drill one well may also be reused for drilling subsequent wells. The maximum amount of water needed to develop the proposed wells under the Proposed Action would be approximately 69.6 acre-feet over the 2-4 year development period.

Under the *Recovery and Implementation Program for Endangered Fish Species in the Upper Colorado River Basin* (RIP), "any water depletions from tributary waters within the Colorado River drainage are considered as jeopardizing the continued existence of these fish." Tributary water is defined as water that contributes to instream flow habitat. Depletion is defined as water which would contribute to the river flow if not intercepted and removed from the system.

The FWS has determined that progress made under the RIP has been sufficient to merit a waiver of the mitigation fee for depletions of 100 acre-feet per year or less (Memorandum dated March 9, 1995 to Assistant Regional Director, Ecological Services, Region 6, from Regional Director 6, "Intra-Service Section 7 Consultation for Elimination of Fees for Water Depletions of 100 acre-feet or Less from the Upper Colorado River Basin"). The Proposed Action would deplete approximately 69.6 acre-feet of water during the 2-4 year development period, and thus a mitigation fee waiver would be applicable. Formal consultation with the FWS regarding Colorado River depletion will be requested for the Proposed Action. This minor level of water depletion would not result in impacts to the endangered fish found downstream of the PRPA.

4.8.1.1.4 Plants

No federally listed threatened, endangered, or candidate plant species are known to occur on the PRPA (Glennon 2004). Ute ladies'-tresses (*Spiranthes diluvialis*), an FWS threatened species, is known to occur in certain habitats along the Green River in Daggett County, Utah, south of the PRPA. Although no suitable habitat for Ute ladies'-tresses occurs on the PRPA, the proximity of known populations in Utah requires field surveys for the plant in Sweetwater County to meet FWS and ESA Section 7 requirements for Environmental Assessments (Glennon 2004). The likelihood of Ute ladies'-tresses occurring on the PRPA is extremely low and no impacts to this species are expected under the Proposed Action.

4.8.1.2 No Action Alternative

Impacts resulting from the implementation of this alternative would be similar to those described under the Proposed Action, but of a lesser magnitude. It is estimated that approximately 73.3 acres would initially be disturbed under the No Action Alternative (see discussion in Section 2.3), due to continuing gas-related activity, which represents about 0.2% of the PRPA. As site reclamation proceeds, the estimated LOP disturbance acres would be reduced from 73.3 acres to 25.8 acres which represents about 0.06% o0f the PRPA.

4.8.1.3 Mitigation

No additional mitigation is required.

4.8.1.4 Residual Impacts

No residual impacts are expected to occur with project implementation.

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 under BLM Manual 6840. The BLM treats these species as candidate species and takes actions to preclude the need for listing. 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

Townsend's Big-eared Bat. Potential habitat for Townsend's big-eared bat does occur within the PRPA and it is possible that it may occur there. Bats are very mobile species and direct impacts upon individual bats are unlikely. The limited amount of suitable habitat for Townsend's big-eared bat that would be impacted under the Proposed Action would result in minor impacts to the species, if it occurs on the PRPA.

Swift Fox. Some portions of the project area may provide limited foraging and denning habitat, however, swift foxes are very adaptable, and the limited amount of disturbance would result in minor impacts to swift foxes, if they are present on the PRPA.

Wyoming Pocket Gopher. Potential habitat exists within the project area for Wyoming pocket gophers. There has been one documented occurrence of a Wyoming pocket gopher approximately ½ mile west of the PRPA (WYNDD 2003) and it is likely that this species occurs within the PRPA. 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). Avoidance of dry ridges with soil types preferred by Wyoming pocket gophers would minimize any impacts to this species. No significant impacts to this species are expected with development of the Proposed Action because habitat disturbance within the PRPA 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). No pygmy rabbit records within six miles of the project area were documented in the WOS (WGFD 2003a) or the WYNDD (2003). The project area is primarily dominated by Wyoming big sagebrush and it is possible that pygmy rabbits could occur on the project area. RSFO wildlife biologists feel that the species may occur within the project area; therefore, stands of tall sagebrush should be avoided where possible to minimize any potential impacts (J. Dunder, 2004).

Approximately 387 acres of various sagebrush habitats would be disturbed under the Proposed Action. This loss of potential 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 significantly impacted because only 1.1% of the sagebrush habitat 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. No mountain plover records within the 6-mile buffer of the project area were reported in the WOS (WGFD 2003a) or WYNDD (WYNDD 2003). Areas providing potential mountain plover habitat were mapped from the ground by HWA in early September 2003. Potential mountain plover habitat closely corresponded to the extent of the white-tailed prairie dog colonies. A total of 4,670 acres of potential mountain plover habitat was mapped, of which,

3,695 acres were located within the PRPA (Figure 3-17). No mountain plovers were observed on the PRPA during the surveys in the fall of 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.

Greater Sage-Grouse. Suitable greater sage-grouse habitat is abundant on and around the project area and specific measures must be taken to avoid impacting this species. Sage grouse are of special concern because populations throughout the west have been declining and they have been petitioned for listing under the ESA. Just over three quarters of the PRPA (33,559 acres) supports a primary vegetation type dominated by one or more subspecies of sagebrush (see Section 3.5). Under the Proposed Action, approximately 194 acres of habitat located within two miles of active sage grouse leks (likely nesting areas) would be disturbed. This equates to approximately 0.6% of the available sagebrush habitat in the PRPA, or 3.6% of the likely nesting areas. Long –term disturbance would be reduced to approximately 60 acres. This amount of habitat disturbance is minimal (1.1% of likely nesting areas) considering the amount of sagebrush available in the project area (approximately 5,500 acres of likely nesting areas). Sage grouse may 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 should be taken to 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 3-18).

Surface disturbance would be avoided within 1/4 mile of the three sage grouse leks within the project area boundary. Approximately 323.3 acres in the project area are located within the 1/4-mile buffer of those lek locations, on which no construction would be authorized except as authorized by exception (refer to 2.2.11.2.9). 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.

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. Suitable habitat for the sage thrasher occurs in the PRPA and the WGFD reported four records of sage thrashers occurring within six miles of the project area (WGFD 2003a). It is likely that sage thrashers use the larger patches of taller sagebrush within the project area. Development of the Proposed Action may displace some sage thrashers, however, suitable habitat is very abundant throughout the project area, and no significant impacts to this species are expected.

Loggerhead Shrike. Three records of loggerhead shrikes are documented within six miles of the project area (WGFD 2003a) and it is likely that loggerhead shrikes utilize portions of the project area during the nesting season. 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. Four records of Brewer's sparrows are documented within six miles of the project area (WGFD 2003a, WYNDD 2003). It is likely that Brewer's sparrows breed within the sagebrush habitats that exist on the project area. The Brewer's sparrow breeds in landscapes dominated by big sagebrush (*Artemisia tridentata*) throughout the Great Basin and intermountain West (Rotenberry et al. 1999). 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 significant impacts to this species are expected.

Sage Sparrow. Sage sparrows typically utilize stands of big sagebrush or mixed big sagebrush and greasewood for nesting. One record of a sage sparrow was documented within six miles of the project area (WYNDD 2003). The project area is dominated by Wyoming big sagebrush and it is likely that sage sparrows occur on the project area. 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 under the Proposed Action 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). Two burrowing owl sightings have been documented within six miles of the project area (WGFD 2003a, WYNDD 2003) and HWA biologists observed burrowing owls at two locations within the PRPA in September 2003. The extensive white-tailed prairie dog colonies within the PRPA provide adequate nesting habitat for burrowing owls. If nesting owls are found on the PRPA during future raptor nest surveys, the same measures used for protection of other nesting raptor species would be applied. Given these precautionary measures, no adverse impacts to burrowing owls are expected to result from implementation of the Proposed Action.

4.8.2.1.3 Reptiles

Midget-faded Rattlesnake. The documented distribution of the midget-faded rattlesnake in Wyoming is west and south of the PRPA. However, the full extent of its range is not well known and the snake could potentially occur, although it is unlikely because of the lack of suitable habitat. Implementation of the Proposed Action is not expected to significantly impact midget-faded rattlesnakes if present.

4.8.2.1.4 Amphibians

Great Basin Spadefoot Toad. One record of a Great Basin spadefoot toad was documented in 1945, approximately seven miles east of the PRPA (WYNDD 2003). Although limited habitat exists in the PRPA, it is possible that Great Basin spadefoots may occur on the project area, where they may utilize intermittent and temporary water sources for breeding during years with adequate moisture. If the measures outlined in this document and the RMP 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

All of the streams within the PRPA are ephemeral and, therefore, do not have the potential to support sensitive fish species, listed by the BLM in Wyoming, on a year-round basis. However, three sensitive fish species are known to occur in streams downstream of the PRPA. These include the roundtail chub, bluehead sucker, and flannelmouth sucker (WYNDD 2003, USDI-BLM 2002). All three species are present in the Green River downstream of the PRPA, while the bluehead sucker and flannelmouth sucker have been collected in Bitter Creek (WGFD 2004). WGFD is entering into a cooperative agreement with other states where these three non-game species are present. The goal of the cooperative agreement is to manage these species to prevent them becoming threatened or endangered. All water produced from productive wells would be disposed of in water disposal wells, therefore, project activities should not affect these fish species of concern found downstream from the PRPA. If all other mitigation measures for soils and water resources in this document are implemented, no significant impacts to the sensitive fish species found downstream of the PRPA are expected.

4.8.2.1.6 Plants

The potential for disturbing plant species of special concern (Table 3-7) on the PRPA is minimal. As stated in Chapter 3, no federally listed threatened, endangered, or candidate plant species are known to occur on the project area, therefore there would be no impacts to these species. The nearest BLM sensitive species (Nelson's milkvetch) population is located about 10 miles from the project area. Wyoming tansymustard has been found closer than 1 mile from the project area, however, its habitat is located on steep slopes that should be avoided per BLM's standard stipulations (Glennon 2004). Potential impacts to plant species of special concern would be minimized assuming construction, maintenance and operation of well pad sites and associated disturbances are in accordance with Chapter 2 of this EA, Warren's APDs stipulations, and FWS/BLM requirements.

4.8.2.2 No Action Alternative

Impacts resulting from the implementation of this alternative would be similar to those described under the Proposed Action, but of a lesser magnitude. It is estimated that approximately 73.3 acres would initially be disturbed under the No Action Alternative (see discussion in Section 2.3), due to continuing gas-related activity, which represents about 0.2% of the PRPA. As site reclamation proceeds, the estimated LOP disturbance acres would be reduced from 73.3 acres to 25.8 acres which represents about 0.06% of the PRPA.

4.8.2.3 Mitigation

No additional mitigation is required.

4.8.2.4 Residual Impacts

No residual impacts are expected to occur with project implementation.

4.9 RECREATION

The study area for recreation resources is the Pacific Rim Shallow Gas Project Area (PRPA), which is part of the 3.5 million acre Rock Springs Field Office. The PRPA contains no developed recreation sites or facilities, areas identified for dedicated use of off-highway vehicles (OHV) or unique recreation resource areas. The area does contain operating natural gas wells developed since 1954 and new gas facilities from Warren's exploratory shallow gas development begun in 2003.

4.9.1 Direct and Indirect Impacts

The Cherokee Trail corridor, which attracts some recreation use, is a mile-and-a-half south of the PRPA boundary and would not be subject to direct effects of the Proposed Action or alternatives. Potential visual impacts to the Cherokee Trail setting are discussed in Section 4.10, Visual Resources.

Dispersed recreation does occur within the PRPA on BLM-administered land, though almost the only recreational use of the area by residents and visitors is big and small game hunting and some pleasure driving for wild horse viewing. Camping and use of OHV that do occur are almost entirely to support hunting.

Under the GRRMP, the recreation management emphasis for the area is continued availability of outdoor recreational opportunities. This is to be accomplished while protecting other resources, meeting health and safety requirements for visitors and mitigating conflict between recreation and other resource uses (USDI-BLM 1997). The proposed action would not conflict with Sweetwater County's policy of protecting unique recreation resources (Sweetwater County 2002), which are absent in the PRPA.

Therefore, the recreation analysis focuses on the issue of displacement of existing, dispersed recreational use by the Proposed Action and alternatives. Impacts to recreation would be significant if the Proposed Action or alternatives were to lead to displacement of dispersed recreation use and if no other area can reasonably provide substitute resources for the displaced recreational activity. The dispersed recreation activities of concern are hunting and wild horse viewing.

4.9.1.1 Proposed Action

The principal reason for displacement of hunting is prolonged displacement of game populations and interference with hunters by project activity, vehicles and equipment. The potential for disturbance by human activity would be greatest during the construction and drilling phase of the Proposed Action when 120 wells would be developed over one to three years at an average spacing of four wells per square mile. These effects would be limited by the implementation of the operator-committed mitigation activities concerning recreation, namely posting warning signs, safety training for equipment operators, requiring adherence to low speed limits and monitoring recreation use of roads, especially during hunting seasons.

Although the construction and drilling phase of the Proposed Action could last up to three years, drilling and completing individual wells would last about two weeks each. Therefore, the disruption of hunting activities associated with the drilling and construction phase of would be

localized and relatively short term. After drilling and construction, the level of human activity would be reduced for the life of the project to the low level associated with production.

Implementation of the Proposed Action would result in an additional 456 acres of surface disturbance on public land during the construction and drilling phase. Partial reclamation of well sites after completion would reduce the total surface disturbance to 138 acres for the life of the project. As noted in the wildlife section of Chapter 4, the disturbance of these acreages during each phase of the Proposed Action would have a low impact on game populations in the PRPA. The amount of land disturbed during each phase also is small in comparison to the total area that provides habitat for the game populations found in the area (see discussions in Section 4.7 for further details).

Human activity and surface disturbance may affect wild horse populations in the area as well, although herds are often seen in proximity to existing gas development in and near the PRPA. Potential effects to viewing of wild horses would be concentrated along primary roads that access the project area, namely WYO 430, SCR 19, SCR 24 and SCR 76, and SCR 77, which also may be used by pleasure drivers.

The analysis indicates that impacts to dispersed recreation in the PRPA would be low and well below the threshold of significance. Some displacement of hunters may occur from areas directly involved in construction and drilling to inactive areas, but the displacement would be temporary as rigs and crews move from site to site over the course of the construction and drilling phase. Minimal disturbance to game populations would occur over the life of project from land remaining disturbed for producing wells, roads and facilities.

The total potential for game habitat to be disturbed by drilling and construction or by production during the Proposed Action would be small compared to the total area of habitat used by game populations in the area. Conflict with recreation traffic would be mitigated by operator-committed activities in the area of traffic control, safety training and monitoring of recreation use of roads during hunting season.

Impacts to wild horse viewing would be low to negligible because the human activity impact is low, surface disturbance is low, and the sensitivity of the wild horse population to these effects is low (see Section 4.7.1.1.3 for further detail).

In addition, new roads developed in the PRPA to support gas development may facilitate access by hunters and wildlife viewers. This would enhance recreation opportunities to some degree in the project area.

4.9.1.2 No Action Alternative

Under the No Action Alternative, development of 108 wells on federal land would be disallowed. However, 12 wells would be drilled on private and state land, so federal land would be disturbed for new roads and pipelines to access those wells. The new roads and pipeline corridors associated with the No Action Alternative would affect hunting and wild horse viewing in ways that are similar in kind to the effects of the Proposed Action but that occur at just a small fraction of the magnitude. Therefore, impacts to dispersed recreation would be low if not negligible under the No Action Alternative.

4.9.2 Mitigation Measures

No additional mitigation measures are necessary.

4.9.3 Residual Impacts

As noted, effects to typical dispersed recreation activities in the PRPA (hunting and wild horse viewing) could exist to at a low if not negligible level during both the construction and drilling and the production phases of the Proposed Action and the No Action Alternative. Though very small, these residual effects would exist even after the implementation of operator-committed mitigation activities concerning recreation resources in the project area.

4.10 VISUAL RESOURCES

4.10.1 Direct and Indirect Impacts

Modification of the landscape from grazing activity is apparent in the PRPA, as described in Chapter 3. Areas of disturbance from operating natural gas wells developed since 1954 are also visible from many viewpoints. Highly disturbed areas from Warren's exploratory development begun in 2003 are visible from SCR 76 and from resource roads in Section 31, Township 15, Range 101. In addition, as described in Chapter 3, the trail setting for segments of the Cherokee Trail south of the PRPA boundary extends into the PRPA.

Therefore, issues related to visual resources would include 1) increases in the extent or scale of visible gas development disturbances in the PRPA, 2) the appearance of project facilities in the PRPA during operations and production and at full reclamation and 3) the procedure for assessing as yet unspecified facilities that may be located within the Cherokee Trail setting during project development.

The analysis of visual impacts to the PRPA reflects guidance from BLM Handbook H-8431-1, Visual Contrast Rating (USDI-BLM n.d. [a]). Briefly, the analysis assesses the degree of visual contrast between the existing landscape character and condition with the character and condition predicted to occur from project development. The level of visual contrast is compared to visual management guidelines for the area, as determined by the visual resource management class designation. The assessment evaluates the compatibility of the development with the management class designation.

Criteria used to judge the significance of the visual impacts to the PRPA are:

- Significant—Predicted visual contrast that exceeds the visual resource management class guidelines,
- Moderate—Predicted visual contrast that is fully at the level of change allowed without exceeding management guidelines, and
- Low—Predicted visual contrast that is clearly below thresholds for visual change allowable by the management classification.

As noted in Chapter 3, all segments of the Cherokee Trail near the PRPA are being managed temporarily as eligible for inclusion in the National Historic Trails system, even though a

determination has not been made as to the eligibility of any of these segments. Under the existing GRRMP management objectives for trails with historic status include protection of landscape quality in areas comprising the visual setting and contributing to a trail segment's historical and cultural character.
The agency would undertake a case-by-case review of project facilities in the setting of the Cherokee Trail near the PRPA. Review would be triggered by applications for permits to drill or by right-of-way applications for individual project components. Details on defining the trail setting and on review procedures are described later in the section.

4.10.1.1 Proposed Action

As noted in Chapter 3, all public lands within the PRPA are in VRM Class IV. Approved development on VRM Class IV lands may result in major modification of the landscape character (USDI-BLM 1997). This allows a strong level of contrast to remain after new facilities are designed and located to reduce contrast with the affected landscape. In addition, the potentially affected landscape in the PRPA includes visible disturbance from scattered producing and shut in wells developed since 1954.

More recently, exploratory development since 2003 indicates the level of contrast to be expected during the development period in the northern Pacific Isle unit below the Rife's Rim escarpment. About 52 acres of initial disturbance from wells and facilities in Warren's exploratory "pod" is visible from resource roads east of WYO 430 near the intersection with SCR 76.

As development in this area indicates, gas facilities designed and sited specifically for broken country with scattered pinon and juniper cover still produce a strong level of residual contrast with the surroundings. In this part of the PRPA, contrasts would usually be visible at relatively short distances because of the potential for intervening terrain features and vegetation. Development in this area also would be visible in the background from accessible parts of Kinney Rim, especially Pine Butte. Middle ground views from the lip of Rife's Rim would be possible, but much of the rim is relatively inaccessible.

Development in the rest of the PRPA, mainly the rolling, brushy slope radiating outward from Rife's Rim, also is predicted to create a strong level of residual contrast after use of design and location strategies. These visual disturbances would usually be seen in the middle ground to background from viewpoints such as CR 19, Pine Butte and Kinney Rim.

Adding 120 new wells and related facilities under the Proposed Action, including 108 on federal land, would greatly intensify the visual impact of gas development in the PRPA. 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. During operation, as drilling and field development is completed and disturbed areas are partially reclaimed, visual impacts would become less evident. After the life of the project from 10 to 20 years after the start of development, all disturbed areas would be reclaimed and the remaining visual contrast would become low after revegetated areas become established and mature.

Operator-committed mitigation activities, such as the use of design and screening strategies, would reduce the visibility of facilities to potential viewers and lower the contrast with the surrounding landscape. These are described in Section 2.2.11.2.11. The adverse effect of

strong contrasts created by the development is also moderated by the relatively low sensitivities in the viewshed, which encompasses lightly traveled county roads and distant overlooks like Pine Butte.

In the short term (during development), adverse visual impacts would be moderate because introducing strong visual contrasts into the landscape is allowable in VRM Class IV. In the long term (during operations and after the life of the project), adverse visual impacts would be moderate to low because part of the disturbed area would be reclaimed after the development phase and all remaining disturbed areas would be reclaimed after the life of project.

4.10.1.1.1 Cherokee Trail

As noted, management objectives expressed in the GRRMP for trails with historic status include protecting landscape within the visual horizon. In the case of the Cherokee Trail, the route is being managed temporarily as eligible for inclusion in the National Historic Trails system, pending legislation and final determination of the contributing segments.

The visual setting, or horizon, for Cherokee Trail segments near the PRPA is the landscape that can be seen from the trail's general route. For this assessment, the visual horizon has been delineated, through analysis of computer maps, for areas within five miles of the route. The defined area resulting from this analysis overlaps approximately 8.5 square miles in the southwest corner of the PRPA**.**

For facilities within the visual horizon, the BLM may require Warren to apply additional measures to reduce, eliminate or mitigate adverse visual effects to the trail setting. The BLM would undertake a case review when Warren submits an APD or right-of-way application for a specific facilities location.

Once a site is specified, overlaying the proposed site map with the map of the Cherokee Trail's visual horizon would identify facilities at risk of adversely affecting the trail setting. Based on the map identification, the BLM would physically inspect the site to verify the potential for an adverse effect, based on visibility of the facility from the trail route and whether unmapped changes on the ground may have rendered the question of impact moot.

If a visual impact were possible from the proposed site, the BLM would initiate a process to determine if the segment possesses features that contribute to the trail's national historic significance. Examples may include trail traces (ruts), monuments or other physical evidence of the past. The determination would be made in consultation with the State Historic Preservation Office (SHPO) and other interested parties, such as the Oregon-California Trails Association (OCTA).

If the segment is determined to be a contributing segment, the operator may be required to apply management practices, similar in kind to those already committed to, to meet a higher visual quality standard than VRM Class IV. The level of mitigation required to approve the facility would be determined by the BLM in consultation with the SHPO and OCTA.

Given that the operator has not specified sites for facilities at this time, the BLM will rely on a case-by-case consultation, established best management practices and experience with similar development to avoid significant adverse effects through the imposition of conditions to permits for well sites and rights-of-way for other facilities.

4.10.1.2 No Action Alternative

Under the No Action Alternative, development of 108 wells on federal land would be disallowed. However, 12 wells would be drilled on private and state land, so federal land would be disturbed for new roads and pipelines to access those wells. The new roads and pipeline corridors would introduce strong contrasts into the federally controlled landscape. However, the total amount of disturbance would be low in comparison to the Proposed Action. Operator-committed mitigation activities that could screen new roads and pipeline corridors from view also would be used to limit impacts under the No Action Alternative.

4.10.2. Mitigation

No additional mitigation measures are necessary.

4.10.3 Residual Impacts

As noted, visual contrasts from wellhead facilities, ancillary facilities and access roads would be visible for the life of the project, even with the use of operator-committed mitigation activities. However, the level of contrast introduced by the disturbance is allowable in VRM Class IV.

4.11 CULTURAL RESOURCES

4.11.1 Direct and Indirect Impacts

4.11.1.1 Proposed Action

Cultural resources on public lands, including archaeological sites and historic properties, are protected by various laws and regulations, for example the National Historic Preservation Act of 1966 (NHPA) and 36 CFR 800. The specific directives can be found in “Archaeology and Historic Preservation: Secretary of the Interior’s Standards and Guidelines” (Federal Register 1983). Laws and regulations concerning cultural resources stipulate the proposed undertaking take into consideration the effects of the action to significant cultural resources. This requires that cultural resources within the proposed area of potential effect (APE) must be identified and evaluated. Measures will be taken to mitigate or minimize adverse effects to historic properties included in, or eligible for, the NRHP.

The PRPA data base contains 76 sites. Of the recorded 76 sites, 33% are recommended eligible for nomination to the NRHP, 6.5% are eligible with SHPO concurrence, 11.8% are recommended not eligible for nomination to the NRHP, 5.3% are not eligible with SHPO concurrence, and 43.4% remain unevaluated. Of the total site types, 79% are prehistoric sites, 11.8% are historic sites, 6.6% are structures, and 2.6% contain both prehistoric and historic components. Prehistoric sites include camps consisting of habitation sites and lithic scatters. The prehistoric lithic debris sites are categorized as lithic scatters, quarry sites, primary and secondary procurement sites. Prehistoric/historic rock alignments, cairns, and rock shelters are documented in the study area. Only two prehistoric/historic sites are documented in the study area. The historic sites include a cabin, a windmill, and two debris sites including a ranching/stock herding debris site.

Potential impacts to specific eligible or unevaluated properties are unknown at this time. Only 22 projects have been conducted in the Pacific Rim study project area. The PRPA

encompasses approximately 74.4 square miles or 47,597.82 acres. Approximately 1372 acres (block) or cumulative area 2.9% of the analysis area have been inventoried at Class III level for an approximate site density of less than one site per acre. The overall site density within the PRPA varies with the highest number of sites located along ridge slopes, in eolian deposits, and near the major topographic land forms. 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.

Mitigation of potential adverse effects is granted to National Register listed sites and sites identified as significant and eligible for nomination to the National Register. Significance is measured by four categories defined by the National Register (36 CFR 60.4):

> "the quality of significance in American history, architecture, archaeology, and culture present in districts, sites, buildings, structures and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association; and that:
>
> - are associated with events that have made a significant contribution to the broad patterns of our history; or
> - are associated with the lives of persons significant in our past; or
> - embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> - have yielded, or may be likely to yield information important in prehistory or history."

For archaeological sites, both prehistoric and/or historic, significance is primarily judged by the site's ability or potential to yield information important in prehistory or history. In other words, significance is based on it's information content and how that information will contribute to addressing local and regional questions, topics, and problems that are germane to the study area are detailed below. The cultural resources within the PRPA can be evaluated with reference to these research objectives.

Advisory Council regulations for Historic Preservation (36 CFR 800.9) are used by the BLM to assess effects to sites deemed eligible for nomination to the National Register. Adverse effects:

- Destruction or alteration of all or part of a property.
- Isolation of a cultural resource from, or alteration of, its surrounding environment.
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting.
- Neglect and subsequent deterioration.

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 significant 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 will 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 significant information. Alteration of the environment abutting eligible historic properties (recommended under Criteria a, b, or c) 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.

Contributing segments of historic trails will be avoided by a ¼ mile buffer zone or within the visual horizon, whichever is closer. These actions are designed to provide protection for the historic trail corridors.

4.11.1.2 No Action Alternative

Impacts to prehistoric and historic properties under the No Action Alternative would be similar to Proposed Action but of a lesser magnitude. These impacts are expected to increase on private surfaces under this alternative.

4.11.2 Impacts Summary

Gauging the effect of any impact depends on the level of information available for that particular property provided by inventory and/or testing data. If cultural resources on or eligible to the National Register are to be adversely impacted by the proposed undertaking, then the applicant, in consultation with the surface managing agency and the SHPO, shall develop a mitigation plan. Construction would not proceed until terms of the mitigation plan are satisfied.

4.11.3 Mitigation

Mitigation procedures will be implemented if a site considered eligible (under “Criterion d” only) or listed on the National Register is impacted. Avoidance is preferred and is achieved through redesign of a project, elimination of the project, or minimizing impacts. However, these means are not always possible. Mitigation of adverse effects to properties would be accomplished by the documentation of physical remains. Mitigation would include data recovery of prehistoric and historic sites and could include documentation through detailed drawings and photographs of standing structures. Data recovery plans are subject to review and approval by the BLM, SHPO, and the Advisory Council on Historic Preservation.

4.11.4 Residual impacts

Avoidance of known significant cultural resources during the construction projects and implementation of Class III cultural resource inventories for the proposed actions minimizes the

potential for adverse impacts to cultural resources. Implementation of protective measures on all lands would result in the avoidance of impacts to cultural resources in the Pacific Rim EA area.

4.12 SOCIOECONOMICS

The study area for potential socioeconomic effects of the Proposed Action and alternatives includes Sweetwater County and the City of Rock Springs.

4.12.1 Direct and Indirect Impacts

4.12.1.1 Proposed Action

The Proposed Action 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, whether locally or non-locally hired, could add to the overall growth and service demand that Sweetwater County and Rock Springs experienced during 2003, depending on the level of gas development that is occurring at the time that drilling and field development activity occurs.

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, the construction industry and from other industries. Expenditures by the Operators 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.

Direct employment effects of the development phase of the Proposed Action would involve contractors and contract employees, for well drilling and completion, pipeline and power line construction, access road and well pad construction, and compressor and generator construction services. These services are available locally, in Rock Springs and other Sweetwater County communities, and regionally, in Casper, Gillette and other Wyoming communities, as well as in nearby locations in Colorado and Utah.

Drilling contractors will be required on a temporary, short-term basis for about six or seven months of each year or less, depending on wildlife restrictions and weather conditions. Completion and other field development contractors would be required temporarily, for a matter of weeks or days, for the duration of a particular task. It is likely that both local and non-local contractors would be hired for the project, depending on such factors as availability, cost and expertise. Locally hired contractors and employees would generate different socioeconomic effects than non-local contractors, who would relocate to the area for the duration of their particular task.

As discussed in Section 2.2.2.3, it is anticipated that two drilling rigs would be operating on-site, and that 10 to 15 workers would be on location at a drill site at any one time, depending on the function being performed (site preparation, drilling, completing, well logging, etc). Including road, gathering system, power line, compression and generation facility construction, on site

employment would average an estimated 42 workers per day during the six to seven month annual drilling period.

During project operations, only one or two fulltime employees in Sweetwater County would be required. The field would require routine maintenance, which would be performed by contractors, and each well would require workover operations every several years, during which time a crew of 4 or 5 contract 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 $77 million capital investment in natural gas wells. The University of Wyoming Agricultural Economics Department has recently performed economic analyses for the Pinedale and Rawlins Resource Management Plans (Taylor 2004). These analyses estimated employment, earnings and total economic activity associated with natural gas drilling and completion activities for a variety of well types in the Pinedale and Rawlins Resource areas. In order to estimate the economic and employment effects of the Proposed Action, the total economic impact, employment and earnings coefficients for similar wells in the Pinedale and Rawlins areas were averaged and adjusted for estimated Pacific Rim drilling and completion costs. Based on these averages and adjustments, it is estimated that each of the 120 shallow gas wells associated with the Proposed Action would generate $692,000 in total economic impact, $165,000 in total earnings and 5.2 direct and indirect annual job equivalents. Each injection well would generate an estimated $1.2 million in total economic activity, 9 annual job equivalents and $285,700 in earnings. All estimates are in 2000 dollars. Annual job equivalents, henceforth called jobs, represent the jobs and portions of jobs totaling one full-time job that would be created by the Proposed Action as well as existing jobs and portions of existing jobs that would be supported in whole or in part by the Proposed Action. These jobs may be direct jobs, created in industries that work in or support gas development or production, or indirect jobs, created in industries supported by Operator, employee and contractor spending and successive rounds of re-spending in southwest Wyoming.

In all, the 120-well drilling phase of the Proposed Action would generate an estimated $95.4 million in total economic impact, $22.6 million in total earnings and 714 direct and indirect jobs. Divided over the three year drilling phase assumed for the socioeconomic assessment, employment would be an estimated 238 direct and indirect jobs per year. The direct employment effects would occur during the six to seven month annual drilling period and include the on-site average of 42 employees discussed above. The 238 jobs represents less than one percent of total 2001 Sweetwater County employment. Note that the local economy may be able to accommodate this additional employment and income with existing capacity therefore, the above employment estimates represent the maximum employment impact of the Proposed Action.

The UW analyses prepared for the Pinedale and Rawlins RMPs also estimated the economic effects associated with 1,000 MCF of natural gas produced in southwest Wyoming at an average sales price of $3.25/MCF. These estimates included an average of $3,919 in total economic impact in southwest Wyoming, $197.50 in earnings and .0052 jobs.

The Operators anticipate that the wells associated with the Proposed Action would produce an estimated 170,689 MMCF over 22 years. Based on the UW estimates, the 120 wells associated with the Proposed Action would generate an estimated $669 million in total economic impact in southwest Wyoming over 22 years, or an average annual economic impact of $30.4 million.

This would include estimated total earnings of $33.7 million (an annual average of $1.5 million), associated with an annual average of 40 direct and indirect jobs. As with drilling, these 40 jobs would represent both existing and new jobs and portions of jobs across a number of industries, located in a number of southwestern Wyoming communities.

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 prices assumed for this assessment, 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. Note that nationally, gas wellhead prices averaged an estimated $5.22/MCF for the first quarter of 2004 (EIA 2004) and year-to-date prices at Wyoming hubs averaged $4.58 MCF (CREG 2004). Nationally, gas prices ranged from $2.19/MCF to $4.98 MCF between 1999 and 2003 (EIA 2004).

Sweetwater County Oil and Gas Activity

Gas production associated with the Proposed Action would represent a small portion of recent Sweetwater County production. Based on operator production forecasts, annual production would begin at 1,456 MMCF in 2005. Peak year production would occur in 2010 at 18,928 MMCF, which is about eight percent of total 2003 Sweetwater County natural gas production.

Assuming that the 120 wells associated with the Proposed Action were drilled in three years, the annual increment in drilling would equal about 6 percent of all Sweetwater County APD applications in 2003. According to WOGCC statistics approved drilling permits issued for Sweetwater County during the first six months of 2004 total 235, a 25 percent reduction in the level of permits approved in the first six months of 2003.

Population Effects

Direct and indirect population effects of the Proposed Action would be minimal, but would contribute to the overall natural gas-related employment and population levels in Sweetwater County and the City of Rock Springs. As noted above, the pace of drilling in Sweetwater County appears to be slowing in 2004, therefore the existing Sweetwater County workforce may be able to accommodate the direct and indirect employment demand associated with the Proposed Action. However, natural gas drilling levels are volatile, and the ability of the Sweetwater County workforce to accommodate the Proposed Action would depend on the overall level of drilling activity in Southwest Wyoming at the time the Proposed Action is implemented.

Drilling and field development activities associated with the Proposed Action would occur during six to seven months each year for two to four years; however, three years was assumed for the socioeconomic assessment. Drilling, completion and field development activities would be performed by contractors, who would 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. Due to the intermittent and temporary 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. This assumption appears to be collaborated by the recent experience of Sweetwater County School District #1 (Rock Springs),

which has experienced continuing declines in enrollment over the past year, a period when natural gas-related activity has increased substantially (Strahorn 2003).

The UW model estimates that a total of 238 direct jobs would be associated with the three year drilling and field development phase of the project. For the purpose of this assessment, it was assumed that 50 percent of these jobs represent currently employed workers who would retain existing employment based on the project-related economic activity. Of the assumed 119 who would relocate to the area, an estimated 40 percent would be single status. It is also assumed that each household would average 2.5 total persons and 1.25 employed persons. These latter two values are Wyoming statewide averages from the 2000 census. These estimates and assumptions would yield a total population of 183 persons during the three year drilling phase assumed for the socioeconomic assessment. This population would be likely distributed across several southwestern Wyoming communities but concentrated in Rock Springs. The total 183 persons would be just under one percent of total 2003 Rock Springs population.

The estimated 40 direct and indirect jobs associated with project operations would similarly reflect existing and new employees in several southwestern Wyoming communities and generate negligible population effects for any one community. Similarly assuming that half of these workers would be workers who retain existing jobs, but because production economic effects are long term, none would be single status, the total population effect would be 40 persons, assuming the statewide average household sizes and employees per household ratios identified above.

Although population effects for the Proposed Action would be minimal, they must be considered in the context of overall natural gas related growth in Sweetwater County. Section 4.12.4 discusses cumulative population growth in the county.

Housing Demand

As described in Section 3.12, there is little availability in either temporary or long-term housing resources in Rock Springs, as a result in the recent surge in natural gas activity. Locally-hired resident drilling and field development workers would already have housing, but non-local workers may have difficulty obtaining longer-term housing resources such as apartments or motels that rent by the week or month. Total housing demand associated with the non-local portion of the Proposed Action-related drilling and field development population (direct and indirect) would be 73 units. There are available mobile home spaces and rooms in more expensive daily-rate motels to fill this demand until workers would be able to find long term housing. Drilling and field development contractors may be required to supply mobile homes for employees or provide higher per diem allowances, depending on the level of natural gas activity at the time Proposed Action-related drilling and field development activity occurs.

The operations phase of the Proposed Action would generate demand for an estimated 16 housing units. These individuals would currently have a difficult time obtaining housing in Rock Springs, although, as discussed above there is some mobile home pad availability in mobile home parks.

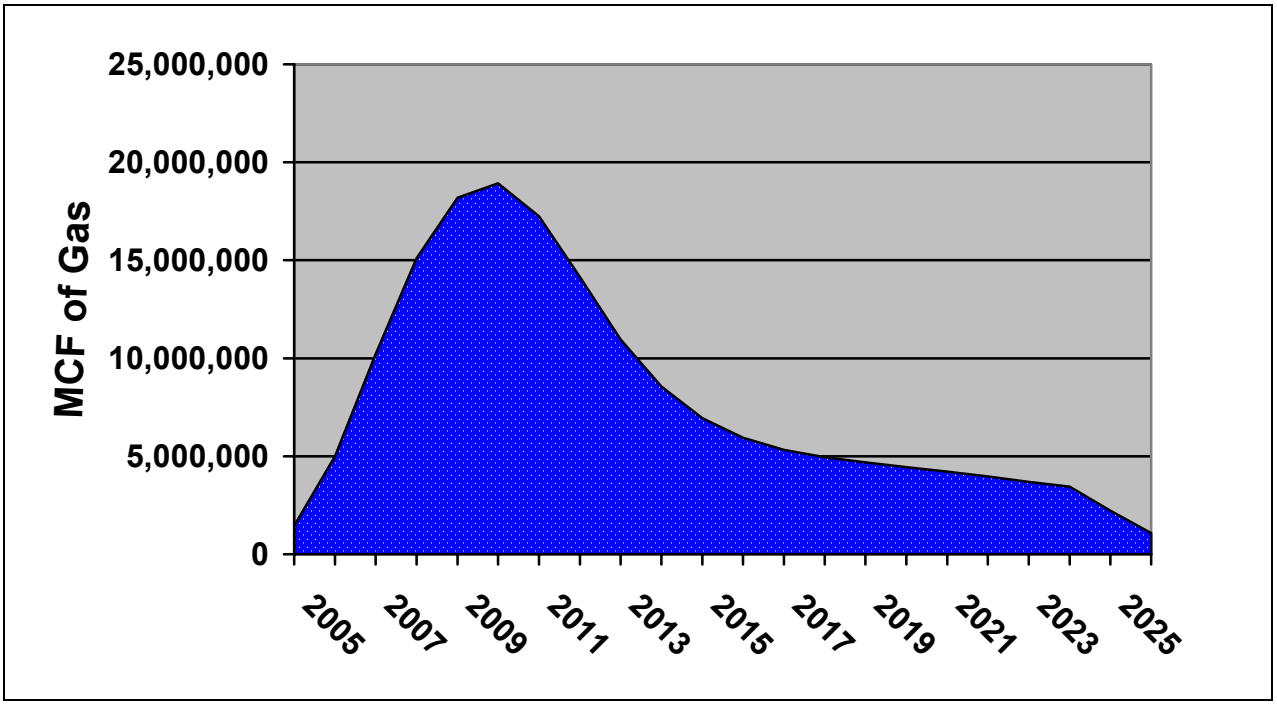
Community Facilities, Law Enforcement and Emergency Response Demand

As described in Section 3.12, most community infrastructure in Sweetwater County and Rock Springs has been sized to serve a larger population than currently exists. Two notable

exceptions are the Sweetwater County Jail (a new jail is under construction) and the Rock Springs sewage treatment facility, which is currently at capacity. The recent surge in natural gas development activity has caused the City of Rock Springs to accelerate plans to expand sewage treatment capacity (Walker 2004). The temporary, short-term employment and population associate with the Proposed Action would contribute to the cumulative sewage treatment demand (see Section 5.12) but that contribution would be minimal and short term. The population increase associated project operations and the secondary employment effects of increased natural gas production would contribute to the longer term demand for sewage treatment facilities, but would be a relatively small portion of overall demand.

County and Rock Springs municipal services such as law enforcement and human services are experiencing increased demand, related primarily to the cumulative surge in natural gas drilling and field development activity (Gordon 2004, Kot 2004, Lowell 2004, Scofield 2004, Vess 2004). The employment and population associated with the development phase of the Proposed Action would contribute to that demand, although the contribution would be relatively minor, temporary and short-term. Service demand associated with the field operations and indirect employment associated with the Proposed Action would be longer-term, but relatively minor and a small portion of overall service demand. Cumulative gas industry effects on community facilities and services are discussed in Section 4.12.4.

Figure 4-2. Estimated Annual Proposed Action-Related Natural Gas Production



Sources: Warren E&P, Blankenship Consulting LLC

Fiscal Effects

The Proposed Action would generate state and local tax revenues including:

- ad valorem property taxes;
- 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). For this assessment, only property taxes associated with production have been estimated.

A constant total levy of 70 mills was assumed for these estimates. In reality some mill levies are set 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 Operator production estimates, US DOE Energy Information Administration price forecasts for natural gas (EIA 2004), and a constant total mill levy of 70 mills, the estimated Proposed Action-related gas production would generate $38.29 million (2002$) in ad valorem property taxes to all entities over 22 years, or an average of $1.74 million/year. Note that property taxes are assessed on the previous year's production and 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.

Of the 120 wells associated with the Proposed Action, 90 percent are anticipated to be on federal minerals. 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 Operator production estimates and USDOE EIA price forecasts for natural gas, an estimated total $52.3 million (2002$) in Federal Mineral Royalties would be generated by the Proposed Action; and approximately $26.1 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 $24.7 million (2002$) 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 120 wells associated with the Proposed Action, an estimated $17.4 million would be spent for goods and services subject to state and local sales and use taxes. This amount would generate about $698,000 in Wyoming sales and use tax revenues, including $481,000 for the State of Wyoming and about $216,000 for Sweetwater County and its municipalities. The local option facilities tax would raise an estimated $87,000 from Proposed Action-related expenditures (2002$).

4.12.1.2 No Action Alternative

Under the No-Action Alternative up to 12 wells could be drilled on private surface, which amounts to 10 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 Alternative would be similar in nature to those described for the Proposed Action, but at about one-tenth of the magnitude.

As with the Proposed Action, population effects of the No Action Alternative would be minimal and result in minor and short-term incremental demand for housing and local government services. Non-local employees would contribute to the current housing shortage and service demand in Sweetwater County and Rock Springs but that contribution would be minor.

Using the multipliers obtained from the UW study, the drilling phase would generate about $9.5 million in total economic impact in southwestern Wyoming, including $2.3 million in earnings associated with 71 direct and indirect jobs. Under the No Action Alternative, gas produced from the PRPA would generate an estimated $66.9 million in total economic impact in southwest Wyoming over the 20 year life of the field, including $3.4 million in earnings associated with an annual average of 4.4 direct and indirect jobs (2002$).

Under the No Action Alternative, it is likely that both the direct and indirect employment associated with field development and operations would be accommodated by the existing Sweetwater County gas service industry, therefore population, housing and community facilities demand associated with the No Action Alternative would be negligible.

Under the No Action Alternative, production-related ad valorem taxes to all entities would total about $3.8 million over the life of the field. State severance taxes would yield about $2.7 million. There would be no federal mineral royalties associated with the No Action Alternative. The drilling program would generate an estimated $69,700 in sales and use tax including about $48,000 for the state of Wyoming and $22,000 for Sweetwater County and its municipalities. The local option facilities tax would raise about $8,700 (2002$).

4.12.2 Mitigation

- The Operator should ensure that its non-local contractors have secured adequate temporary housing for employees.
- The Operator should ensure that all purchases of tangible goods are properly credited to Sweetwater County for sales and use tax purposes.
- The Operator 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 offset 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 Direct and Indirect Impacts

4.13.1.1 Proposed Action

Transportation effects of the Proposed Action would occur primarily on WYO 430 and SCR 4-24, 4-76, 4-77 and 4-19. These public roads provide access to the PRPA from Rock Springs, where the majority of project related traffic would originate. Transportation impacts would also occur on operator-maintained roads within the PRPA. The increases in traffic associated with the Proposed Action could accelerate highway and county 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 or minimize these impacts.

<u>Wyoming State Highway 430</u>

The Proposed Action would generate increases in traffic volumes on WYO 430. 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 171 one-way trips, or an average of 11 trips per day over the 16 day well staking, pad construction, drilling and completion cycle, and the peak daily traffic could be as high as 23 trips. Field development activities such as production testing, construction of gas gathering, water disposal, electrical power distribution and wellhead compression systems would generate additional traffic, during periods when that hose activities occur.

The Proposed Action anticipates drilling 120 wells in two to four years. For the transportation assessment, a three-year, 40 well/year drilling program was assumed. It is also assumed that wildlife and seasonal stipulations would reduce the drilling period to six or seven months/year. Based on these assumptions and a two-rig drilling and field development simulation, an estimated annual 9,894 one-way trips would be generated by the Proposed Action during each year of drilling and field development. This is an average daily traffic (ADT) of 54 one-way trips per day over the six-month day drilling cycle, or an average-annual daily traffic (AADT) increase of 27 trips on WYO 430. On a few peak days, traffic could reach over 100 one-way trips under the simulation conducted for this assessment. It is estimated that about 40 percent of all trips would involve trucks larger than 2½ tons. Note that these estimates reflect a three-year drilling schedule; if drilling and field development occur over two or four years, the annual number of trips would be reduced or increased accordingly.

During project operations and reclamation, daily maintenance and operations activities would be performed by one pumper. Routine well and field facility maintenance would occur on an intermittent basis and incremental one-way trips would average less than 10 per day, except during well workovers, which might average 5 to 10 one-way trips/day for several days depending on the operations that would be performed.

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 4-30, the closest traffic count location to the PRPA. Estimated project-related AADT (27) would be about 30 percent of 2002 AADT (90) on WYO 430. However, the Proposed Action AADT and 2002 AADT combined (117) would be less than 2001 AADT and about 43 percent of 1992 AADT for all traffic. Average-annual daily truck traffic would be 54 percent of 2000 levels, but Proposed Action truck AADT (11) and 2002 truck AADT (20) combined would still be less than 2001 truck AADT (35) on this segment. Average daily traffic during the six-month drilling period (54) would be about 60 percent of 2002 AADT, 42 percent of 2001 AADT and about 20 percent of 1992 AADT on the segment. Average daily truck traffic (22) during that period would be about 10 percent higher than AADT truck traffic in 2002, 63 percent of AADT for truck traffic in 2001 and 44 percent of 1992 truck traffic.

While WYO 430 could accommodate the temporary, short-term traffic volumes associated with the Proposed Action with out deterioration in level of service, 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.

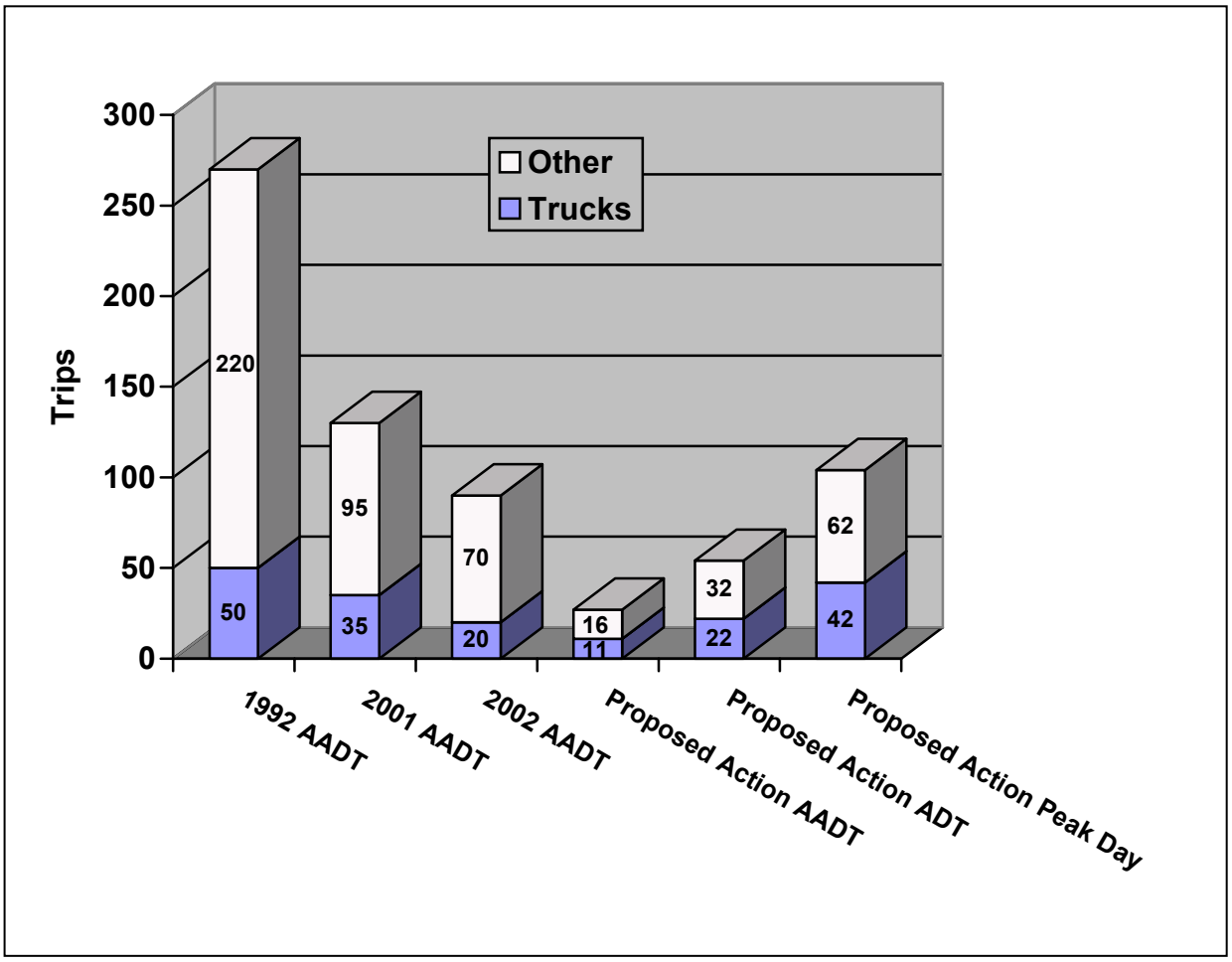
County Roads

The Proposed Action would result in substantial short-term increases in traffic on the county roads that provide primary access to the PRPA (SCR 4-24, 4-76, 4-77 and 4-19) during the drilling and field development period. Currently SCR 4-24 and 4-19 provide access to oil and gas fields in the area and are improved and frequently maintained, although the southern segments of these roads receive substantially less traffic and maintenance than the more highly used northern segments. In contrast SCR 4-76 and 4-77 provide access to ranches, grazing operations and recreation areas (hunting) and are constructed of native material and lightly used and infrequently maintained, but use of these two roads for drilling and field development access would be limited. The Proposed Action-related increase in traffic, particularly heavy truck traffic, would accelerate deterioration of all county roads. Excessive speed or use of the

roads when 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 and SCR 4-19 (Gibbons 2004).

Sweetwater County's cost associated with accelerated road maintenance requirements and dust control on county roads would be offset by the Proposed Action-related ad valorem and sales and use tax revenues generated to county government, and by Operator contributions of gravel to the county for use in road reconstruction and maintenance. Although sales tax

Figure 4-3. Proposed Action-Related Traffic on WYO 430 compared to 1992, 2001 and 2002 AADT



Sources: 1992, 2001 and 2002 AADT, WYDOT 2002 Vehicle Miles Book. PA (Proposed Action) AADT, ADT and Peak Day traffic, Blankenship Consulting LLC.

revenues are returned to the county fairly rapidly, property tax revenues from Proposed Action-related production would not begin to accrue to the county until the year after production begins.

Internal Roads

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 PRPA. The Operators anticipate constructing or reconstructing an estimated 35.64 miles of resource roads to access new well locations including 32.1 miles on BLM surface and 3.5 miles on private or state surface. The Operators 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 AO and be designed, constructed and maintained in compliance with the standards contained in BLM Manual 9113.

4.13.1.2 No Action Alternative

Implementation of the No Action Alternative would result in increased traffic on State, county and resource roads because gas leases could be developed on private lands and potentially approved for BLM-administered lands on a case-by-case basis. For the No Action Alternative, it was assumed that 12 wells and associated production facilities would be developed on private lands during one year using one rig. Transportation impacts similar to those described under the Proposed Action could occur, but at a reduced level. Based on a 12-well simulation, an estimated 3,762 one-way trips would be generated during field development. This would be an ADT of 37 trips during the 103-day drilling cycle or an AADT of 10, about 11 percent of 2002 AADT on WYO 430 at the turn-off to SCR 4-30. A projected 61 trips would occur on the peak day.

The effects of No Action Alternative-related traffic on WYO 430 would be substantially less in magnitude and duration, compared to the Proposed Action.

Portions of the same county roads required for access to the Proposed Action would be used to access private and state lands under the No Action Alternative. Drilling and field development – related impacts on these roads would be of substantially less magnitude and duration than impacts under the Proposed Action, but anticipated revenues to Sweetwater County would also be about 90 percent less.

Similarly, the resource road network required to access wells would be substantially smaller than under the Proposed Action. The Operators would be required to construct and maintain resource roads under the No Action Alternative, and to comply with BLM, State and landowner imposed standards for road construction.

4.13.2 Mitigation

Mitigation for impacts on State highways would include:

- Obtaining all required WYDOT permits and approvals for constructing or improving road access to WYO 430.
- Coordination with WYDOT and the Sweetwater Road and Bridge Department to ensure that all approaches to WYO 430 are adequate to handle tractor trailer combinations.
- Coordination with WYDOT and the Sweetwater Road and Bridge Department to ensure that all approaches to WYO 430 are paved or otherwise treated to allow trucks to shed mud gravel before entering the highway.

Mitigation for County Roads would include:

- Obtaining access permits and/or licenses from the Sweetwater County Engineer's Department for any crossings, access to or utilization through Sweetwater County road rights of way.
- Participation in the Wamsutter – Continental Divide Transportation Planning Committee, if appropriate.
- Operator and contractor policies to reinforce speed limits and other traffic safety laws on county and operator-maintained roads within the PRPA.
- Assistance to the Sweetwater Road and Bridge Department in obtaining gravel, water and dust suppressant for application on affected county roads.

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 Direct and Indirect Impacts

4.14.1.2 Proposed Action

Potential health and safety effects associated with the Proposed Action 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 Action 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; that increased risk would be reduced but not eliminated during field operations.

<u>Occupational Hazards</u>

The USDI-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 operators and hunters), 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 PRPA 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. Compliance with signing requirements for pipeline rights-of-way would 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 PRPA operator and contractor employees. A Hazard Communication Program, Spill Prevention Control and Countermeasure (SPCC) Plans, and other mitigation measures described in Section 2.2.11.2.16 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.

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 2.2.11.2.16.

The potential for firearms-related accidents would occur primarily during hunting season. The increased activity in the PRPA during drilling and field development would be likely to discourage hunting in the immediate vicinity of the activity during that period. 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 risk would be 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 Alternative

The health and safety risks identified under the Proposed Action could also occur under the No Action Alternative, given that up to 12 wells could be developed on private and state land. The magnitude of risk would be substantially 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, risks to public health and safety would minimal under the No Action Alternative.

4.14.2 Mitigation

The Operators 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, 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 Direct and Indirect Impacts

4.15.1.1 Proposed Action

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 facility noise impacts.

Implementation of the Proposed Action has the potential to create noise-generated impacts that emanate from machinery used during drilling and completion 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 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 a mile or less from the compression site. There only one residence located with in the PRPA and the Operators would not locate compression facilities within 1.5 miles of this residence. Intervening topography between the residence and compressor stations would further reduce noise impacts. 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 2.2.11.2.12, noise impacts to the public associated with the Proposed Action would minimal and for the most part, short-term in nature.

4.15.1.2 No Action Alternative

Up to 12 wells could be developed on private and state lands under the No Action Alternative. 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. As with the Proposed Action, the few 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

In addition to measures described in Section 2.2.11.2.12, measures to mitigate noise impacts would include the following:

- In any area of operations (drill site, compressor site, etc.) where noise levels may exceed federal OSHA safe limits, The Operators and 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 497 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 development (RFDs) 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 GRRMP 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 DEVELOPMENT (RFD)

RFDs are organized by CIA area and include the following:

5.2.1 Pacific Rim Project Area

Historic and existing activities in the PRPA include cattle grazing, dispersed recreation and oil and gas exploration, development and production. Reasonably foreseeable development within the PRPA is 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 significant changes in the Proposed Action are warranted, additional NEPA assessment (including cumulative impact analysis) would be required.

5.2.1.1 Disturbance within the Pacific Rim Project Area

Existing disturbance within the PRPA is approximately 15.9 acres (see Table 5-1), or around 0.03 percent of the 47,598 acres comprising the project area. During the construction phase, the Proposed Action would disturb 497.5 acres. Under the No Action Alternative disturbance would be 73.3 acres (Table 2-4). Disturbance areas within the PRPA area would be reduced upon reclamation of pipeline ROWs 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 153 acres for a cumulative impact of 168.9 acres or 0.35 percent of the PRPA. No Action Alternative impacts would decrease to 25.8 acres, with cumulative impacts affecting 41.7 acres or about 0.09 percent of the PRPA.

Table 5-1. Types and Approximate Acreage of Surface Disturbance on Federal Land – Existing.

Existing									
	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 Gas Wells	12	0	0	12		12	0	0	12
Number of disposal wells	1	0	0	1		1	0	0	1
Gas Well Pads[1]	2.4	0	0	2.4		13.2	0	0	13.2
Disposal Well Pads[2]	0.9	0	0	0.9		1.2	0	0	1.2
Roads[3]	12.6	0	0	12.6		15.8	0	0	15.8
Compressors(5)	0	0	0	0		0	0	0	0
Gathering Pipelines [4]	0	0	0	0		15.8	0	0	15.8
Delivery Pipelines[5]	0	0	0	0		15.8	0	0	15.8
Total	**15.9**	**0**	**0**	**15.9**		**61.8**	**0**	**0**	**61.8**

[1]Assumes initial disturbance of approximately 1.1 acres for each well pad and LOP disturbance of 0.2 acre per well pad.
[2]Assumes initial disturbance of approximately 1.2 acres per well pad and LOP disturbance of 0.9 acres per well pad.
[3]Assumes an average of 0.33 mi of new roads with a 30-ft average disturbance width for each well. All disturbance except for the estimated 14-ft wide road travelway and adjacent ditches would be reclaimed for the LOP.
[4]Assumes an average of 0.33 mi of new gas gathering and water discharge lines with a 30-ft average disturbance width for each well. All disturbance will be reclaimed for the LOP.
[5]Assumes an average disturbance width of 50 ft. All disturbance will be reclaimed for the LOP.

5.3 CUMULATIVE IMPACTS ANALYSIS

Table 5-2 details the cumulative impacts by resource area associated with the Pacific Rim 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 not more than 2.1 percent of any one area assessed, the Proposed Action would not result in considerable degradation to the resource. Figure 5-1 shows the locations of mineral development projects in the cumulative impact area of analysis of the Pacific Rim Shallow Gas Project.

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 actions and RFDs 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 RFDs. Protection of subsurface mineral resources is provided by the BLM casing and well bore cementing policy.

The development of oil and gas wells and associated infrastructure as described for the Proposed Action and No Action Alternative, as well as other foreseeable and unforeseen projects, including mining of surface mineral resources and construction materials may have cumulative impact on paleontological resources. Construction can directly impact fossil resources and newly built roads can open previously inaccessible areas to illegal collecting and destruction of fossil resources by vandalism. Scientifically significant fossils and fossil localities containing them are rare and not uniformly distributed throughout the geologic deposits in the PRPA. Loss of fossil resources from rare and scientifically important localities and the loss of the localities themselves by destruction may have an unforeseen cumulative effect.

Development could, however increase the potential for discovering scientifically significant fossil resources, if the nature and significance of the paleontological material is recognized; adequate measures would be applied to ensure proper treatment and recovery of the resource.

5.3.2 Air Quality

Cumulative air quality impacts are defined as the result of the combination of emissions resulting from the Proposed Action, existing permitted sources within and surrounding the Proposed Action, and potential emissions from reasonably foreseeable development. While it is anticipated that the pace and level of natural gas development within this region of the State would continue over the next few years, RFD sources were not quantified for this analysis.

Table 5-2
Cumulative Assessment by Resource Value
Pacific Rim 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-	PRPA[5]	47,598	15.9 ac	153 ac	25.8 ac	Existing disturbance + PA would result in 168.9 ac of disturbance or 0.35% of the project area.
Minerals	Area from U.S. 191 east to boundary of CD/WII & DF project area	1,898,464	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	Concentrations would remain in compliance with standards. Impacts to visibility and atmospheric deposition may be significant.
Soils	Affected watersheds: East Salt Wells Creek, North Fork Vermillion Creek, Alkali Creek	236,991	391 ac	153 ac	25.8 ac	Existing and PA would result in disturbance of in 544 ac of disturbance or 0.23% 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: East Salt Wells Creek, North Fork Vermillion Creek, Alkali Creek	236,991	391 ac	153 ac	25.8 ac	Existing and PA would result in disturbance of 544 ac or 0.23 % within the affected watersheds. Avoidance and/or protective measures required.
	Groundwater – Expected drawdown area (cone of depression)	Approximately sub-surface 639,587				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 WYO 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 538 ac of disturbance (0.15%) of cwyrl range. Timing limitations required.
Wildlife – Big Game Species	Petition Elk Herd Unit South Rock Springs Herd Unit	1,836,488 (27,388 cwyrl) 777,948 (130,453)	33,654 ac (220 ac cwyrl)	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance of 40,285 ac or 1.5% of the herd units. 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:		Potential Cumulative Impacts (life-of-project disturbance only)
				Proposed Action[3] (PA)	No Action[4]	
Wildlife – Big Game Species	Bitter Creek Antelope Herd Unit South Rock Springs Antelope Herd Unit	1,835,828 (212,222 cwyrl) 778,464 (679,574)	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 1.6% of the herd unit. Existing disturbance + PA would result in 2,210 ac or 0.25% disturbance to cwyrl range. RFD - timing limitation required.
T/E/P/C/S Wildlife Species Note: PA - No effect determination for T/E/P/C species	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 - 60 ac potential nesting	6,569 ac total 0 Leks No Action - 26 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 60 ac of potential habitat or 0.02% of potential nesting habitat found in planning unit. Foreseeable actions addressed on a case-by-case basis. Timing limitations or avoidance of usable habitat required.
	Raptors – PRPA + 2 mi buffer	116,078 (23,100 ac nesting + ½ - 1 mi buffer)	33.0 ac	153 ac	25.8 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)	47,598	15.9 ac	153 ac	25.8 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		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	Adobe Town Wild Horse Herd Management Areas	1,573,585	18,410 ac	6,631 ac	6,569 ac	Existing, PA + RFD would result in disturbance of 25,041 ac or 1.6% of the Adobe Town WHHMA.
Recreation	PRPA + 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	PRPA + adjacent areas in southern Sweetwater County		On-going and proposed oil and gas related activity, coal mining, interstate traffic, livestock grazing, etc.			Existing, 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	PRPA + 5 mi Buffer	217,198	255 ac	153 ac	25.8 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	PRPA, 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.
Health/Safety	PRPA	47,598	15.9 ac	153 ac	25.8 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.

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]	
Noise	CFPA	24,953	15.9 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 89 wells in the Copper Ridge 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 120 wells will be successful producers under the Proposed Action resulting in a LOP disturbance of 153 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 12 wells will be successful producers under the No Action Alternative resulting in a LOP disturbance of 25.8 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.

5/- PRPA surface is 47,598 acres total, comprised of 41,739 acres Federal ownership (87.7% of total), 3,900 acres private ownership (8.2% of total), and 1,959 acres State of Wyoming ownership (4.1% of total).

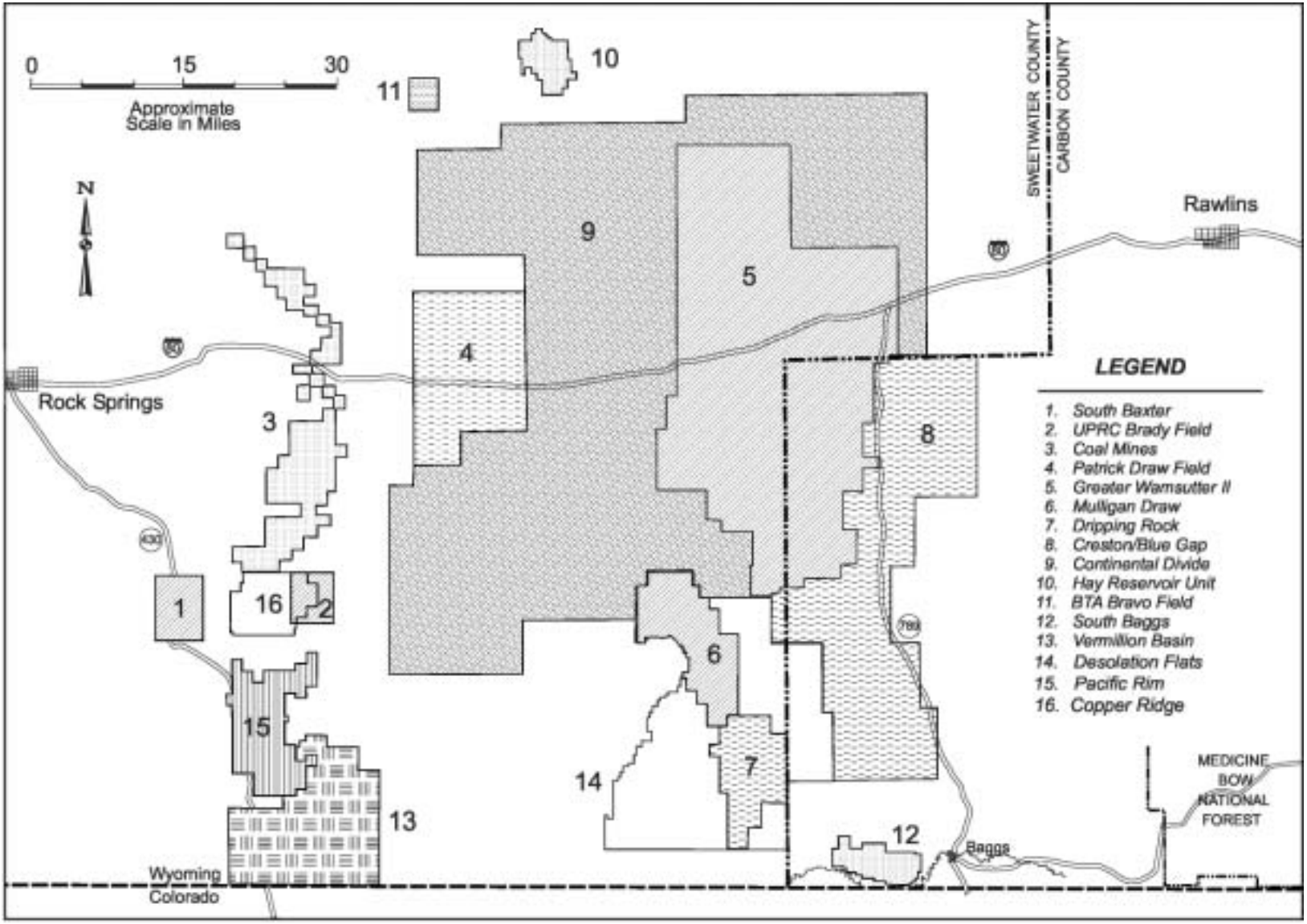


Figure 5-1. Location of other Mineral Development Projects in relation to the Pacific Rim Project Area.

5.3.2.1 Cumulative Criteria Pollutant Air Quality Impacts

The latest version of the ISCST3 dispersion model was applied with regulatory default options to predict maximum cumulative criteria pollutant air quality impacts within 20 kilometers of the PRPA. Five years of Rock Springs surface and corresponding Lander upper air meteorological data were utilized (1991-1995), and adjustments to predicted annual NO_x concentrations were made in accordance with the Ambient Ratio Method (ARM) as specified in EPA's Guideline on Air Quality Models (EPA 2003a).

Appendix A-1 provides a list of the NO_x and CO emission sources that were included in the cumulative modeling analysis. Maximum emissions were integrated by applying potential-to-emit permitted values for NO_x and CO and by assuming continuous source emissions. Tables 5-3 and 5-4 compare the maximum predicted cumulative air quality impacts with the appropriate NAAQS and PSD Class II increment. Since there are no PSD increments for CO, only the NO_2 increment is presented in Table 5-3. As shown, the predicted cumulative impacts are less than the applicable NAAQS and PSD Class II increment. Additional impacts that have not yet been quantified are anticipated from RFD sources within the cumulative assessment area.

Table 5-3. Cumulative Impact Comparison to NAAQS

Pollutant and Averaging Time	Maximum Proposed Action plus Existing Permitted Source Impact ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Cumulative Impact Plus Background ($\mu g/m^3$)	NAAQS Std. ($\mu g/m^3$)	Percent of NAAQS
NO_2 Annual	11.0	3.4[a]	14.4	100	14%
CO 1-hour	597.8	2,299[b]	2896.8	40,000	7%
CO 8-hour	146.7	1,148[b]	1294.7	10,000	13%

[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 5-4. Cumulative Impact Comparison to PSD

Pollutant and Averaging Time	Maximum Proposed Action plus Existing Permitted Source Impact ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Percent of Increment
NO_2 Annual	11	25	44%

5.3.2.2 Cumulative Air Quality Related Value (AQRV) Impacts

Cumulative AQRV impacts resulting from existing emission sources, RFD sources, and the Proposed Action, would be much the same as those found in similar oil and gas analyses 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 2002; Bureau of Land Management 2003). Table 5-5 presents a summary of potential cumulative AQRV impacts resulting from the Desolation Flats analysis (USDI-BLM, 2003). Emissions from the Proposed Action would contribute incrementally to the cumulative impacts previously documented. However, given the relative magnitude of the Proposed Action emissions, it is unlikely that the project would strongly influence cumulative AQRV impacts.

Table 5-5. Summary of Potential Far-Field Air Quality from Desolations Flats EIS.

Air Quality Component	Comment
Potential Air Pollutant Concentrations	
Criteria Air Pollutants	• Far-Field total concentrations are in compliance with applicable NAAQS and WAAQS o Particulate matter concentrations 13 - 40% of standards o NO_2 concentration 10% of standard o SO_2 concentrations 4 – 8% of standards • Far-Field project concentrations are well below applicable PSD Class I increments o PM_{10} concentrations .002 - .4% of increments o NO_2 concentration .4% of increment o SO_2 concentration .005 - .07% of increments
Visibility	
Days with > 1.0 ΔdV	• Potential visibility impacts from the Desolation Flats project were less than the FLAG visibility threshold • Potential cumulative visibility impacts were greater than the FLAG visibility threshold o 7 days in Bridger Wilderness o 2 days in Fitzpatrick Wilderness o 0 days in Popo Agie Wilderness o 1 day in Wind River Roadless Area o 0 – 1 day in Dinosaur National Monument o 1 day in Savage Run Wilderness o 1 day in Mount Zirkel Wilderness o 0 – 1 day in Rawah Wilderness

Table 5-5. Summary of Potential Far-Field Air Quality from Desolations Flats EIS (cont.).

Air Quality Component	Comment
Days with > .5 ΔdV	• Potential visibility impacts from the Desolation Flats project were less than the USFS/NPS visibility threshold • Potential cumulative visibility impacts were greater than the USFS/NPS visibility threshold o 11 - 16 days in Bridger Wilderness o 2 days in Fitzpatrick Wilderness o 7 – 8 days in Popo Agie Wilderness o 7 day in Wind River Roadless Area o 8 - 10 day in Dinosaur National Monument o 6 - 7 day in Savage Run Wilderness o 3 day in Mount Zirkel Wilderness o 4 - 5 day in Rawah Wilderness
Atmospheric Deposition	
Lake Chemistry Level of Acceptable Change (LAC)	• Decreases in ANC from the Desolation Flats project alone were less than the lake chemistry LAC (level of acceptable change) • Cumulative decreases in ANC were less than the lake chemistry LAC for sensitive lakes o 6% of LAC for Black Joe Lake o 7% of LAC for Deep Lake o 3% of LAC for Hobbs Lake o 2% of LAC for Ross Lake o 9% of LAC for Lower Saddlebag Lake o 13% of LAC for Seven Lake o 22% of LAC for West Glacier Lake o 5% of LAC for Island Lake o 9% of LAC for Rawah #4 Lake • Cumulative decreases in ANC were less than the lake chemistry LAC for very sensitive lakes o 46% of LAC for Upper Frozen Lake o 32% of LAC for Pothole A-8 o 32% of LAC for Upper Slide Lake

5.3.3 Soils

The CIA area for soils includes the affected watersheds encompassing 236,991 acres. Cumulative impacts include soil impacts from on-going exploration and development activities, recently constructed projects, and RFDs, as described in Table 5-2. Cumulative disturbance of 544 acres would be approximately 0.23 percent of the 236,991 acre CIA area. This amount of cumulative impact upon the soil resources would be minimal, provided that all mitigation and avoidance measures are implemented.

5.3.4 Water Resources

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.

Historic and existing activities in the PRPA include livestock grazing, dispersed recreation, and oil and gas exploration, development, and production. Reasonably foreseeable developments within the CIA area are the Proposed Action, the Copper Ridge Shallow Gas Project and the Vermillion Basin Natural Gas Exploration and Production Project. The Copper Ridge Shallow Gas Project is located approximately four miles north of the PRPA and the Vermillion Basin Natural Gas Project is located immediately south and east of the PRPA, a portion of the Vermillion Basin Natural Gas Project area overlies the southeastern corner of the PRPA.

Cumulative impacts to surface water resources would be maximized shortly after the start of construction activities, decreasing in time due to reclamation efforts, and 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.

The surface water resources CIA area includes those watersheds that would be affected by both the Proposed Action and the adjacent Copper Ridge Shallow Gas and Vermillion Basin Natural Gas Projects. That area includes approximately 236,990 acres encompassing three affected watershed, which are East Salt Wells Creek, Alkali Creek, and North Fork Vermillion Creek. Existing, proposed, and known future surface disturbance would result in approximately 544 acres, or 0.23 percent of the CIA area potentially disturbed.

Cumulative groundwater impacts from shallow gas development are expected to occur as the result of groundwater withdrawal from the Almond Formation coal seam aquifer. The Vermillion Basin Natural Gas Project is a conventional natural gas development that would not involve the removal of groundwater for the production of natural gas. However, the Copper Ridge Shallow Gas Project, like the Pacific Rim Shallow Gas Project, would withdraw groundwater from the Almond Formation coal seam aquifer; therefore, a cumulative hydraulic pressure head loss is expected to occur. The assessment of cumulative impacts to groundwater related to shallow gas development in the CIA area is based on impact predictions made for the Proposed Action and the Copper Ridge Shallow Gas Project to the north due to the potential for overlapping cones of depression.

Another drawdown model (Theis, 1935) was created to simulate the maximum cumulative drawdown expected to occur from the Proposed Action and the Copper Ridge Shallow Gas Project. The Theis model was performed using the same hydraulic parameters that were used for the individual project drawdown predictions. An anticipated steady-state discharge rate of seven (7) gpm was assigned to each of the 89 shallow gas well locations to simulate the Copper Ridge Proposed Action in addition to the five (5) gpm assigned to each of the 120 shallow gas well locations for the Pacific Rim Proposed Action. After 20 years of these constant discharge rates, the model predicts that the groundwater resources CIA area (the area within the 10-foot

drawdown contour) will extend approximately 13 miles north and 12 miles east of the Copper Ridge project area and approximately 12 miles south and 12 miles east of the PRPA, and it includes approximately 1,000 square miles (639,587 acres). Ten feet of drawdown represents less than one percent of the estimated available head (hydraulic pressure) in this area.

Figure 5-2 depicts the modeled maximum extent of drawdown within the Almond Formation coal aquifer due to cumulative groundwater withdrawals by the Proposed Action and the Copper Ridge Shallow Gas Project. This prediction depicts a conservative estimate since drawdown would occur only to the extent needed to allow the gas to desorb. These discharge rates would likely decline over time, reaching zero in the later stages of the projects.

Due to thick confining layers above and below the Almond Formation coal seams, wells completed in water-bearing strata above or below the depressurized coal seams are not likely to be impacted.

In addition to drawdown in the affected coal seam aquifer, the geologic unit(s) chosen for subsurface disposal of shallow gas-produced water would also be cumulatively affected by both the Proposed Action and the Copper Ridge Shallow Gas Project. As addressed in Chapter 4, little data are available at this time to describe the geologic unit(s) that would be chosen to be the injection target. 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, which may or may not be the same for both shallow gas projects. In the event that an injection well would cease to operate properly due to formation over-pressuring or mechanical failure, the respective operator must still remain in compliance with all applicable regulations governing the operation of the produced water disposal system.

Current and future oil and gas exploration and development activities in the CIA area must comply with federal and state environmental regulations. Therefore, impacts to groundwater quantity and quality on a cumulative scale are not expected. This is particularly true given the fact that wells would be completed in accordance with Onshore No. 2 and recent BLM guidelines that reduce the potential for groundwater contamination.

5.3.5 Vegetation and Wetlands

Both the Proposed Action and No Action Alternative would add to the cumulative removal of vegetation and biological soil crusts within the area. Because of the widespread distribution and abundance of the Wyoming big sagebrush and desert shrub cover types in the project area and southwestern Wyoming, minor reductions in upland cover types would not be a substantial adverse impact.

Any non-permitted impacts to riparian/wetland areas would add to the cumulative loss in Wyoming and the Continental U.S. However, development of the PRPA would occur on upland areas and would not add to cumulative wetland impacts. Due to a paucity of riparian/wetland sites within the project area, the probability of drill site construction impacting these resources is very low. These sites, if present, are further protected by RMP requirements of a minimum 500-foot avoidance buffer between surface disturbing activities and riparian and other water resources. Also, permits under Section 404 of the Clean Water Act would be required for any activities in jurisdictional wetlands. Warren would be required to demonstrate to the COE that, “no practical alternatives” to placement of a well location in a wetland is present. Potential impacts to wetlands/riparian sites would be assessed and mitigated on a case-by-case basis.

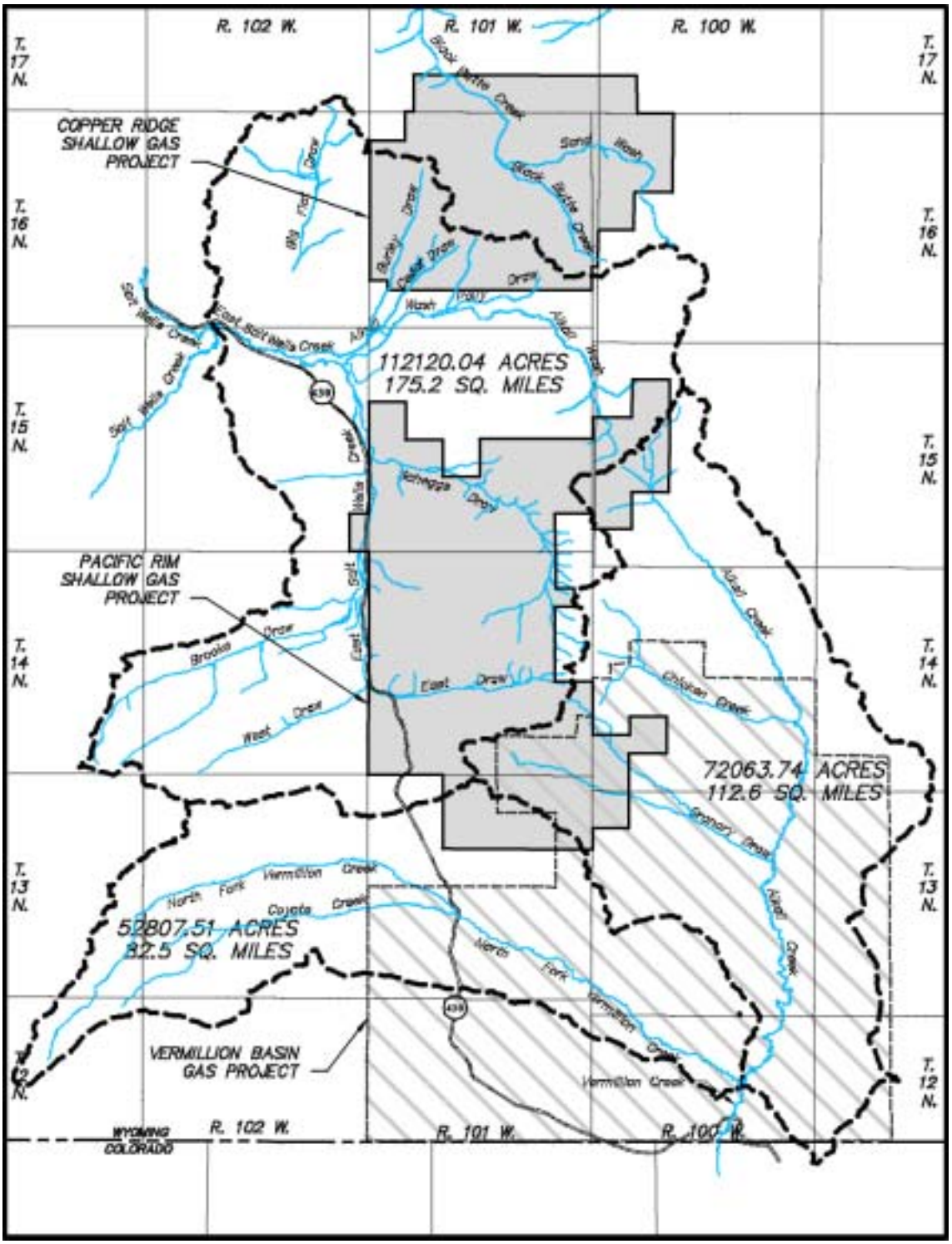


Figure 5-2: Pacific Rim Shallow Gas Project Cumulative Impact Analysis Area.

Affected Watersheds:

East Salt Wells Creek =	112,120.04 acres
North Fork Vermillion Creek =	52,807.51 acres
Alkali Creek =	72,063.74 acres
Total =	236,991.29 acres

Compliance with well pad construction, maintenance and operation, and mitigation procedures specified in Chapter 2 of this EA, APD stipulations, and the RMP would minimize the potential for cumulative impacts to occur as a result of project implementation.

5.3.6 Range Resources and Other Land Uses

Existing land management and use activities that have impacted the general area in various degrees include livestock grazing, road construction and use, and construction of other gas/oil facilities such as drill pads and pipelines. The additional area of disturbance resulting from implementation of the proposed action would not substantially add to the cumulative impacts already occurring in the area.

In the long term, cumulative impacts to the grazing resource would likely result in a small net loss in total annual forage production. For example, as mentioned in 4.6.1.1, successfully reclaimed sites in the Green River Basin produce at a rate of about 6 acres per AUM (USDI-BLM 1999b). Using data from Table 2-1, it can be seen that the difference between the estimated initial disturbance area for the Proposed Action (497.5 acres) and the estimated LOP disturbance area (153.0 acres) is about 344.5 acres. Based on the 10.5 acre/AUM stocking rate previously used, this amounts to a permanent loss of 14.6 AUMs. However, over the LOP, 344.5 acres would be successfully reclaimed, and based upon a 6 acres/AUM stocking rate, approximately 57.4 AUMs would be reestablished. If reclamation is this successful, there would be a net gain of 42.8 AUMs. Over time, native shrubs such as Gardner's saltbush, winterfat, and Wyoming big sagebrush would re-establish from nearby established seed sources and provide browse for wildlife and wild horses.

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. Due to the relatively high production potential of these species and the relatively small amount of long-term habitat disturbed (0.4% of the PRPA), small mammal and songbird populations would quickly rebound to pre-disturbance levels following reclamation, and no long-term impacts to these populations are expected.

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 and development of the project would not contribute to cumulative impacts in the Petition or South Rock Springs Herds. Pronghorn crucial winter/yearlong range occurs on 6,705 acres within the PRPA (15.5% of the project area). The proportion of pronghorn crucial winter/yearlong range within the Bitter Creek Herd Unit that would be affected by existing and proposed disturbance would be approximately 1.1% of the available crucial winter range. Mule deer crucial winter/yearlong range occurs on 7,648 acres within the project area (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 by existing and proposed disturbance would be approximately 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. Figures 5-3, 5-4, and 5-5 show elk, pronghorn, and mule deer herd unit seasonal ranges with respect to the PRPA.

Development activities associated with the project are not expected to impact wild horses in the long-term, given their adaptability and free-roaming nature, habituation with on-going activities, and low levels of vegetation removed by project implementation. Compliance with well pad construction, maintenance and operation, and mitigation procedures and stipulations as stated in Chapter 2 of this EA, Warren's APDs, and the RMP would minimize the potential for cumulative impacts to wild horses.

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. Figure 5-6 shows sage grouse leks and a 2-mile buffer area in relation to the PRPA.

Activity of raptor nests within one mile of the PRPA was not recorded in 2003, but will be determined prior to well development. Figure 5-7 shows raptor nests and a one-mile buffer area in relation to the PRPA. Protective measures will be implemented to limit disturbances within one mile of active raptor nests. Implementation of protection measures identified in Chapter 2 and the RMP are expected to protect the raptor populations and cumulative impacts are not expected.

5.3.8 Special Status Plant, Wildlife, and Fish Species

5.3.8.1 Mammals

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 wildlife species. Thus, impacts are expected to be minimal.

5.3.8.2 Birds

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.

5.3.8.3 Fish

Formal consultation with FWS will be completed. Impact payments to the FWS for recovery efforts are not expected to be required. All known foreseeable actions require consultation with the FWS if downstream fish are affected.

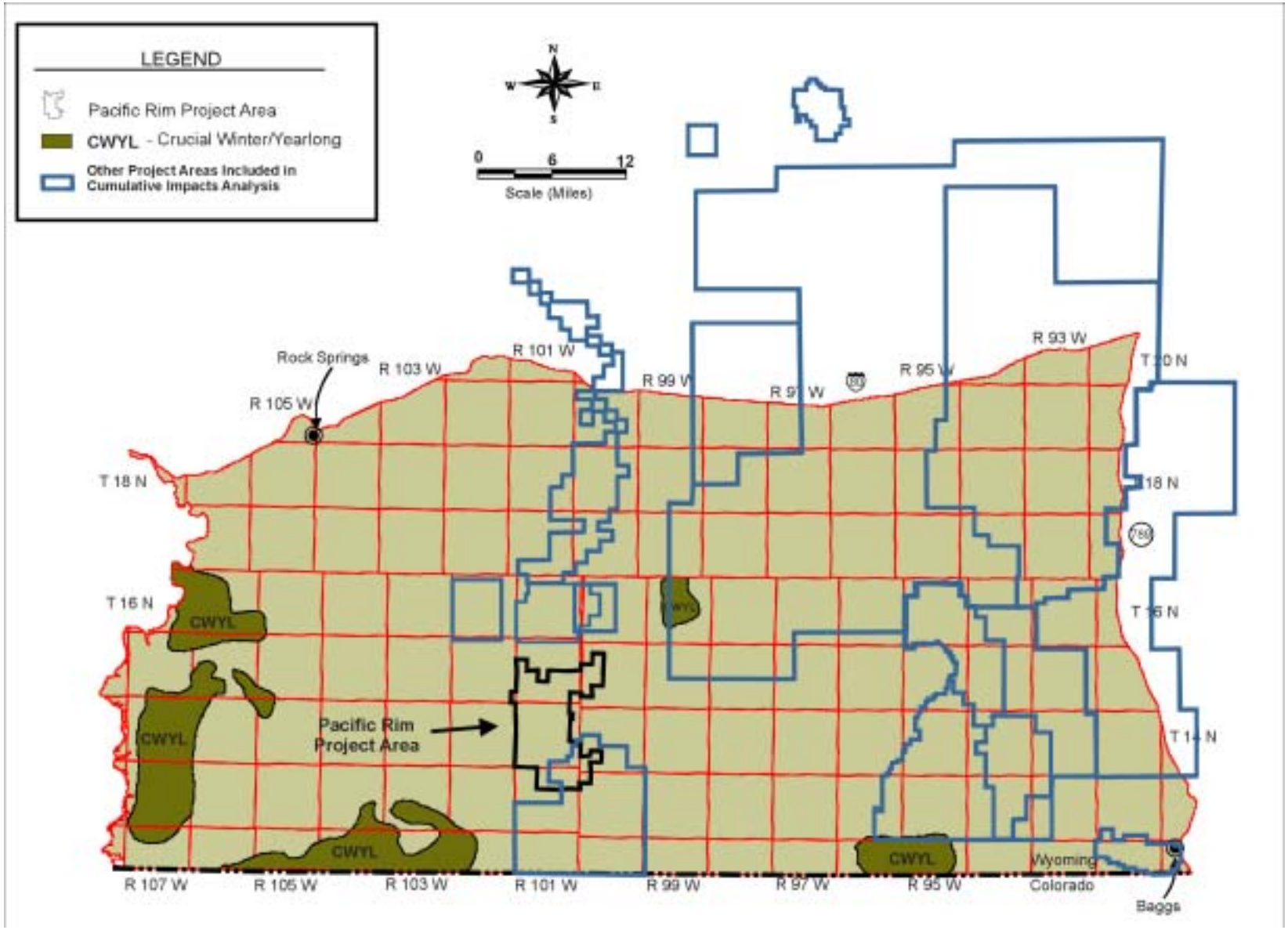


Figure 5-3. Petition and South Rock Springs Elk Herd Unit seasonal ranges in relation to the PRPA.

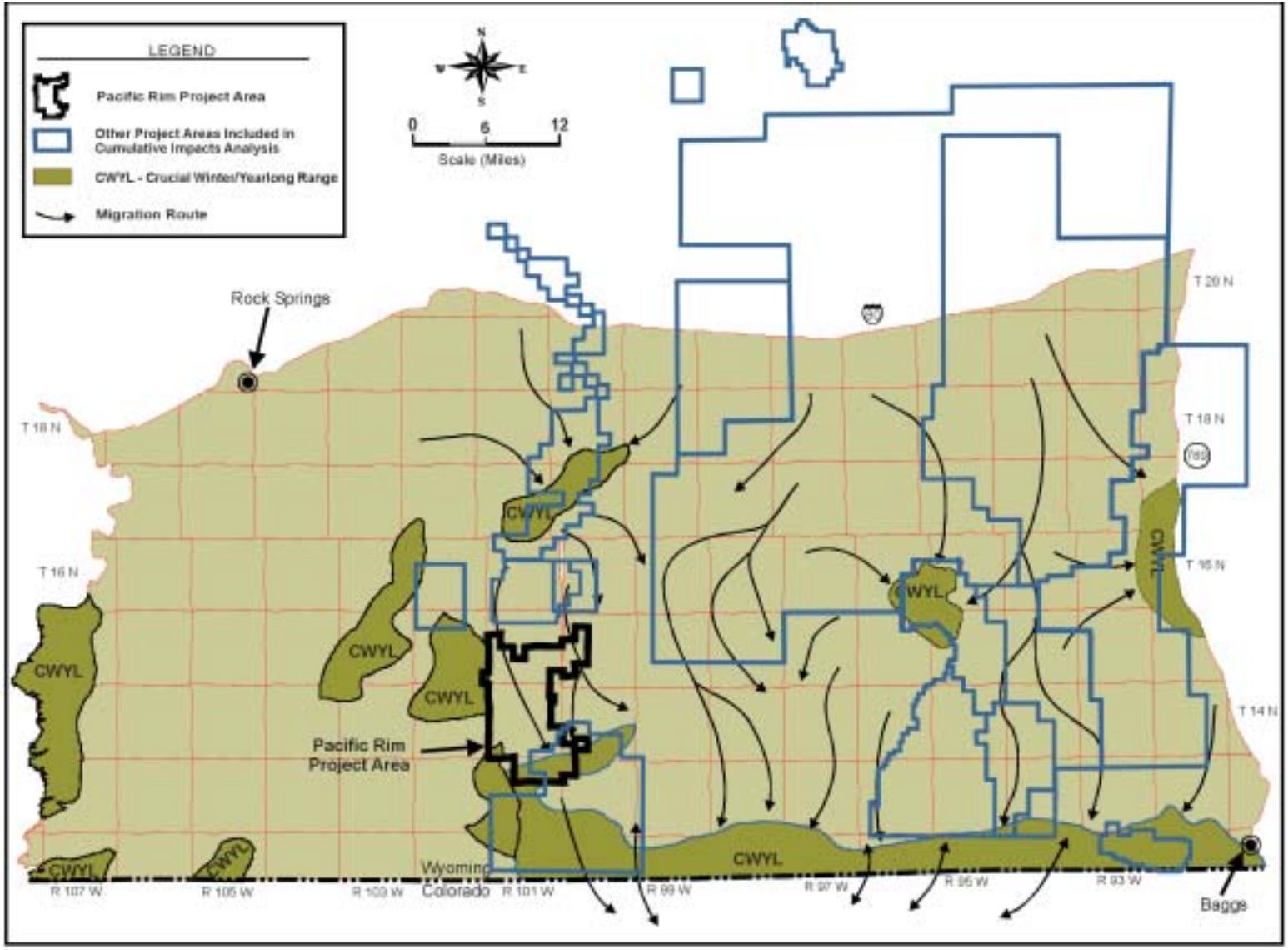


Figure 5-4. South Rock Springs and Bitter Creek Pronghorn Herd Units seasonal ranges in relation to the PRPA.

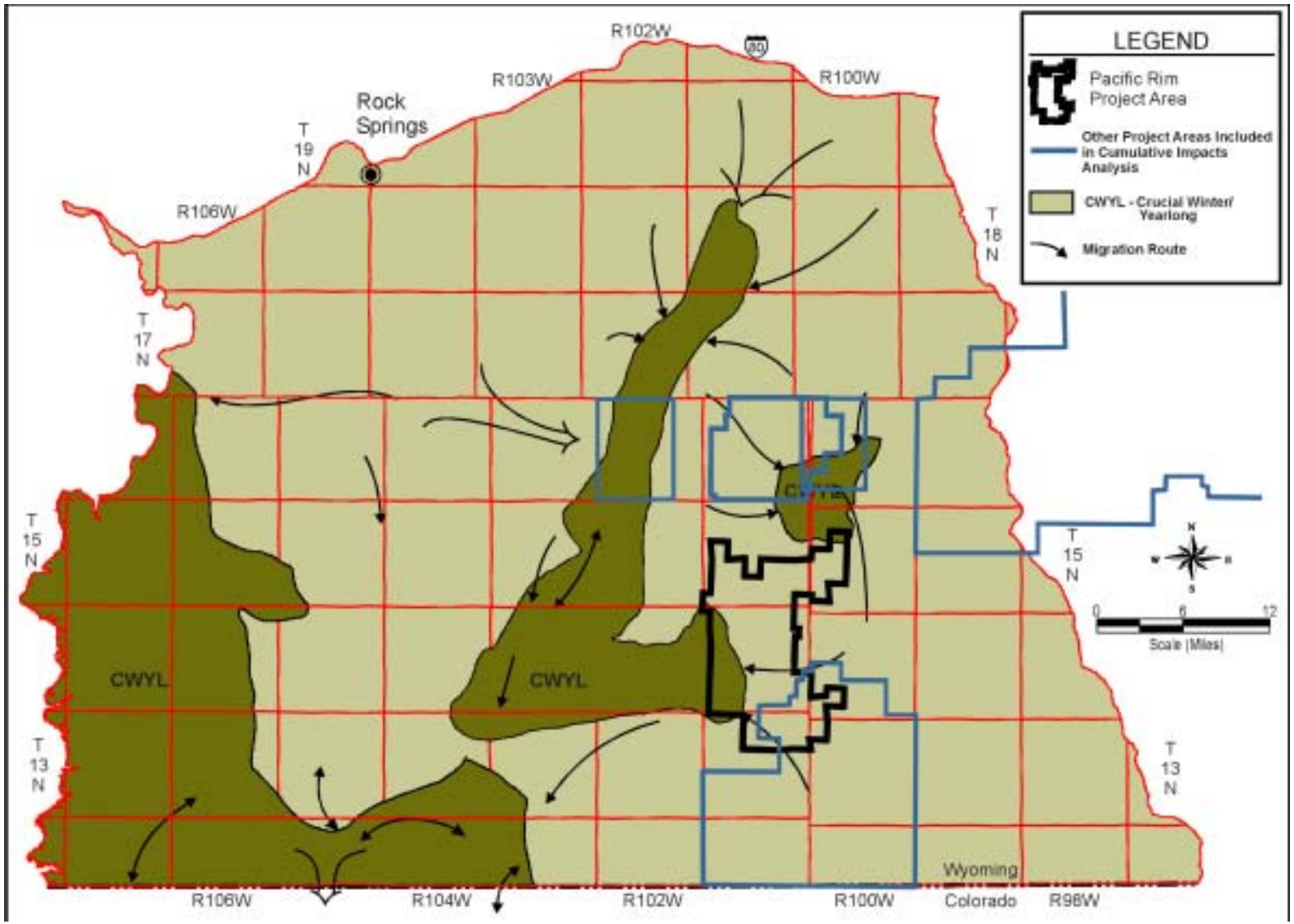


Figure 5-5. South Rock Springs Mule Deer Herd Unit seasonal ranges in relation to the PRPA.

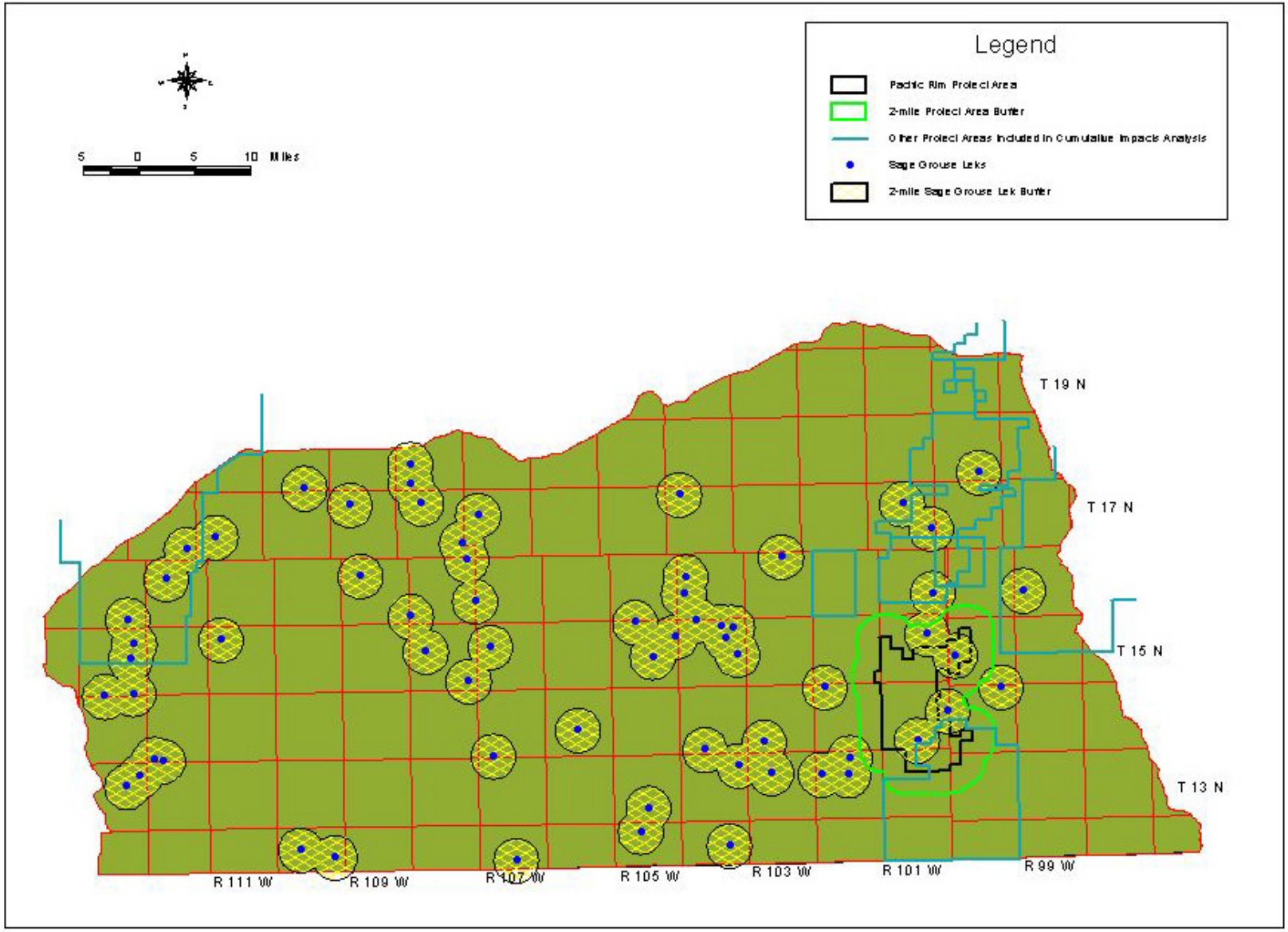


Figure 5-6. Sage grouse leks in relation to the Pacific Rim Project Area.

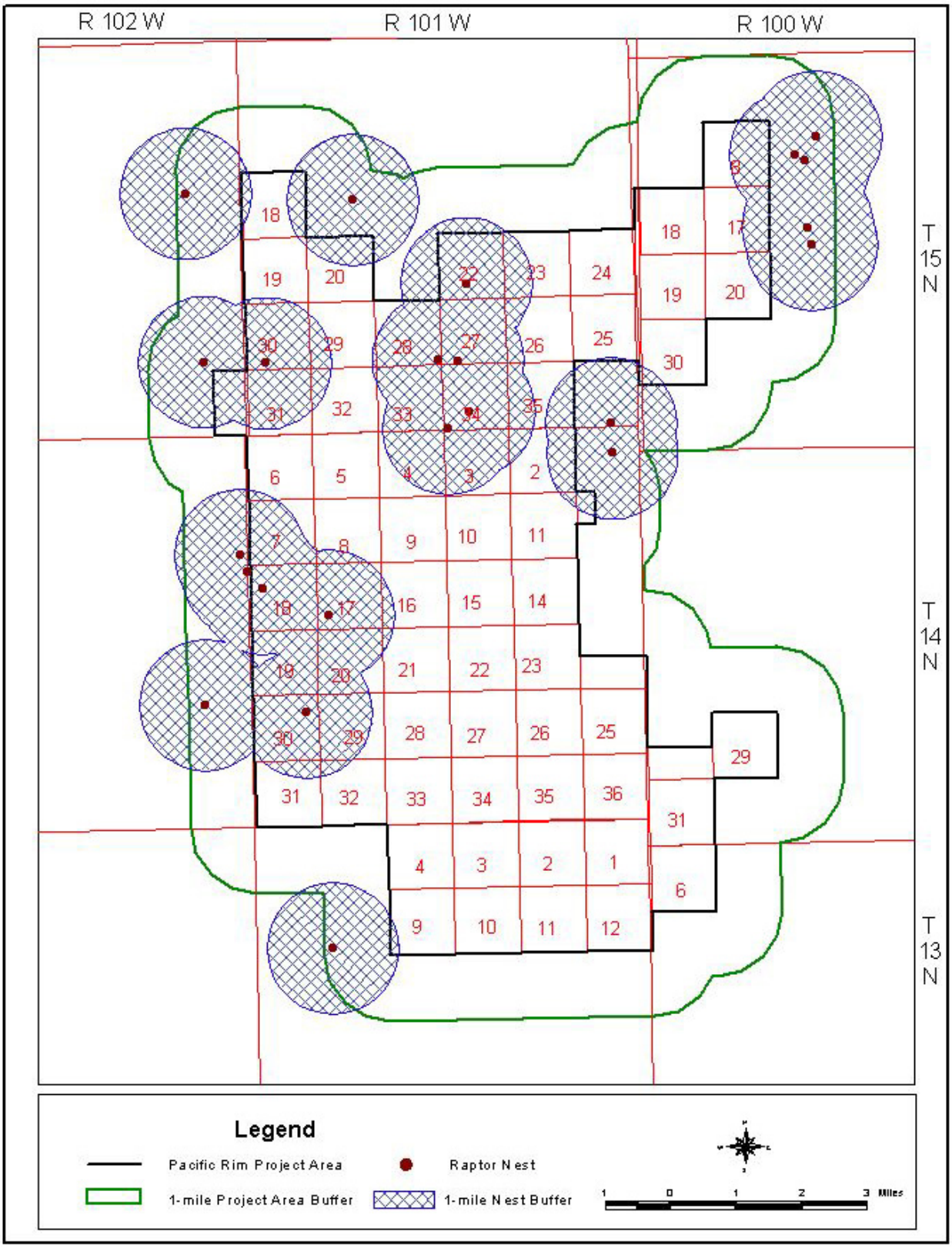


Figure 5-7. Raptor nests in relation to the PRPA.

5.3.8.4 Plants

The probability of occurrence of habitats for plant species of concern on or near the proposed project area is low; therefore, no adverse cumulative impacts to these habitats are anticipated due to project implementation. 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 cumulative impacts to Special Status Plant Species are expected.

5.3.9 Recreation

The cumulative impacts analysis area for recreation resources is the PRPA. Cumulative effects within the area include existing development from the Kinney Rim North, Kinney Rim South and Vermillion Basin natural gas projects and existing disturbance from Warren E & P's exploratory development. These effects are part of existing conditions in the affected environment; therefore, cumulative impacts are the same as impacts for the Proposed Action and No Action alternatives.

Briefly, all existing recreational activities would continue on the project area at near existing participation levels. Hunters may avoid areas of human activity such as construction drilling and completion, and human activities would change the character of the area and diminish recreational experiences, such as wild horse viewing and big game hunting, for some participants. Cumulative effects are not anticipated to result in significantly reduced populations of game animals; therefore impacts to hunters and hunting would not be significant.

A negligible amount of opportunity for dispersed outdoor recreation may be lost on the PRPA for the life of the project. After the LOP, opportunities for recreation on the PRPA would return to existing levels.

5.3.10 Visual Resources

The cumulative impacts analysis area for visual resources is the PRPA. Cumulative effects within the area include existing development from the Kinney Rim North, Kinney Rim South and Vermillion Basin natural gas development.

These effects are part of existing conditions in the affected environment; therefore, cumulative impacts are the same as impacts for the Proposed Action and No Action Alternative.

To summarize the cumulative impacts to visual resources would be moderate during drilling and construction and moderate to low during operations and after the life of the project. This level of visual contrast is compatible with the VRM Class IV rating of the PRPA, assuming the performance of operator-committed mitigation activities included in the proposed action and described in Chapter 2.

Segments of the Cherokee Trail which skirt the PRPA to the south pass through the Vermillion Basin natural gas project area, The BLM will rely on a case-by-case consultation, established best management practices and experience with similar development to avoid adverse cumulative effects to the visual setting of the Cherokee Trail by imposing conditions as needed to permits for well sites and rights-of-way for other facilities.

The addition of gas development and production facilities and associated roads would cause unavoidable, low to moderate adverse impacts to visual resources in the PRPA and potentially to the visual setting of the Cherokee Trail. The impact would occur throughout the LOP and for some time into the future, since reclaimed lands may take many years to approach pre-disturbance visual characteristics.

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

Over the past year, Sweetwater County has experienced a substantial increase in the pace and level of natural gas development. Continued growth in demand and price coupled with production declines in other states, increases in pipeline capacity and improvements in exploration, drilling and production technologies have resulted in increased interest in both conventional and unconventional gas resources in the Green River Basin. Drilling and field development is occurring across the county and in areas near the PRPA including Copper Ridge, Continental Divide/Wamsutter II, Hay Reservoir, Vermilion Basin and potentially, Desolation Flats. While this increase in development has resulted in increased employment, income and tax revenues in the region, it has also resulted in increased housing demand and increased demand for local government facilities and services, particularly in Rock Springs, which serves as a regional oil and gas service center for the Green River Basin.

As described in Section 3.12, Rock Springs is still below peak population levels of the 1980's and most infrastructure is able to accommodate population growth. The major exceptions are the County jail, which is under construction and the Rock Springs sewage treatment plant, which is at capacity and must be expanded several years ahead of schedule (Walker 2004). Resources of certain county and community services, such as law enforcement and human services agencies are currently being strained as calls for service and caseloads increase to respond to the natural gas-related development.

Local government officials and community leaders in Sweetwater County and Rock Springs are currently working to identify current and future impacts of natural gas-related growth on housing resources, on local facilities and services and on local government fiscal conditions (Gordon 2004). They plan to enlist State government and the natural industry in an effort to plan for and

accommodate the industry-related growth.

The recent surge in natural gas development has occurred over the last 12 to 18 months. As shown by Figure 3-20, Sweetwater County APDs increased by 68 percent between 2002 and 2003. This has resulted in the increases in housing demand and the effects on law enforcement and human services described above and in Section 3.12. Population statistics usually lag current events by one or more years, therefore it is not possible to estimate the amount of gas industry related growth that has occurred in Sweetwater County and Rock Springs. Moreover, it is difficult to determine if the natural gas–related growth will stabilize, continue to expand or decline. As noted in Section 3.12., Sweetwater County has gone through both major and minor expansions and contractions over the last several decades in response to natural gas and other commodity market conditions. Given that drilling and field development associated with the Proposed Action will occur over a two to four year period, it is difficult to predict whether the activity associated with the Proposed Action can be accommodated by existing service industry capacity in the county, or will be part of a demand that will result in further expansion. In either case, the employment and population effects associated with the seasonal operation of two shallow gas drilling rigs and associated completion and infrastructure development would represent a minor portion of the overall demand. For example, the 40 wells/ per year scenario used for the socioeconomic assessment would represent about 6 percent of the 675 APDs submitted in 2003. Nevertheless, it will be important for the Operators to ensure adequate housing for company and contract employees, and participate in county and municipal efforts to reduce the impact of the natural gas- related growth.

5.3.13 Transportation

Cumulative transportation impacts on County and operator-maintained roads would be limited to existing traffic and that associated with the Proposed Action or No Action alternatives. Cumulative impacts on WYO 430 would include traffic associated with the Copper Ridge development to the north of the PRPA and the Vermillion Basin development to the south. Excluding the Pacific Rim project, the trend in traffic has been decreasing on WYO 430. Combined AADT associated with the proposed Copper Ridge and Pacific Rim projects would be 89, which would almost double 2002 AADT (90) on the highway, but would be about 68 percent of 2001 AADT and 33 percent of 1992 AADT. Estimated AADT associated with the Vermillion Basin project is not available.

5.3.14 Health and Safety

Cumulative health and safety impacts within the PRPA would include those associated with existing natural gas operations, proposed natural gas development and existing grazing and recreation activities and natural hazards. These combined activities would be pose minimal risk to public health and safety.

5.3.15 Noise

The Proposed Action, operations of existing oil and gas facilities, occasional vehicular traffic associated with grazing operations and recreation visitors and aircraft over-flights are the only noise generating RFDs anticipated for the PRPA. For the most part these noise-generating activities would be temporary and dispersed and therefore not anticipated to create substantial cumulative noise impacts.

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 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 Pacific Rim 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 October 17, 2003 requesting input into the proposed Pacific Rim 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 fifteen (15) 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 concerns and 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 6-1) and the consultant IDT (Table 6-2) that were principally involved with preparing this EA.

Table 6-1. List of BLM Interdisciplinary Reviewers

Name	Responsibility
ROCK SPRINGS FIELD OFFICE	
Darlene Horsey	Project Manager
John MacDonald	Soils/Pipeline construction/reclamation
Susan Davis	Petroleum Engineering
Jim Dunder	Wildlife/T & E Issues
Chris Durham	Wildlife/T & E Issues
Kevin Lloyd	Range Management
Jim Glennon	Botany
Terry A. Del Bene	Cultural Resources
Jo Foster	Recreation
Jennifer Bates	Realty
Dennis Doncaster	Hydrology/Water Quality
John Henderson	Fishery Biology
Steve Wiig	Geology/Paleontology
Stephen Boyer	Transportation
Angelina Pryich	Writer/Editor
Mike Holbert	Field Manager
Ted Murphy	Assistant Field Manager – Land and Minerals
Bernie Weynand	Assistant Field Manager - Resources

Table 6-1. List of BLM Interdisciplinary Reviewers (cont.)

Name	Responsibility
WYOMING STATE OFFICE	
Susan Caplan	Air Quality
Roy Allen	Socioeconomics
Janet Kurman	Environmental Protection Specialist/NEPA Coordinator
Vickie Mistarka	Minerals and Lands/Fluid Minerals
Brenda Vosika Neuman	Physical Scientist
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
Jana Pastor	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	Socioeconomics, Safety, Transportation, Noise
Lloyd Levy	Lloyd Levy Consulting	Recreation, Visual

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APPENDIX A

SUMMARY OF SCOPING NOTICE COMMENTS AND BLM RESPONCES

The Scoping Notice was released for a 30-day public review period on October 17, 2004. Fifteen comment letters were received. The letters have been reviewed to determine whether the information they provided would warrant a determination other than a Finding of No Significant Impact (FONSI). Substantive comments with responses are summarized below (in italics) with the BLM responses to each immediately following the comment. The BLM would like to thank all commentors for taking the time to review the scoping notice and provide comments.

1. **Wyoming Game and Fish Department (WGFD)**

a. *Terrestrial Considerations:*
The project area lies primarily within the boundaries of the Bitter Creek antelope herd unit, south of Rock Springs mule deer herd unit, and the Petition elk herd unit.

Section 4.7.1.1.2 Big Game and page 5-17 section 5.3.7 discussed the Bitter Creek antleople herd and the elk herd unit. Activities associated with the construction phase would likely displace antelope and mule deer; however, once construction is completed they would likely habituate and return to pre-disturbance activity patterns.

b. There are three (3) known sage grouse leks found within or adjacent to the project area.

Section 4.8.2.1.2 and page 5-18 section 5.3.7 discuses the Greater sage-grouse and their leks. 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. Figure 5-6 shows sage grouse leks and a 2-mile buffer area in relation to the PRPA.

c. *Aquatic Conditions*
This project is adjacent to the North Fork of Vermillion Creek. The creek supports a population of Brook trout in the headwaters and a population of Mountain suckers and Speckled dace.

See section 2.2.11.2.6 and section 3.4 of the EA. All of the streams within the PRPA are ephemeral and, therefore, do not have

the potential to support BLM Wyoming state sensitive fish species on a year-round basis. Studies indicate that the non-game, native species may ascend ephemeral tributary streams to spawn. Thus, ephemeral drainages fed by runoff from the project area may provide habitat for sensitive fish on a seasonal basis only. No fisheries mitigation is needed beyond that indicated under Water Resources and Special Status Species Fish.

2. **Petroleum Association of Wyoming (PAW)**

a. *Address socio-economic impacts and the positive affects the project will have for the State of Wyoming. A section should discuss the "local economy" significance criteria.*

Section 3.2 discusses the socioeconomics of the project. A detailed analysis of Sweetwater County population, employment, earnings and personal income trends through the year 2000 has been developed by the joint efforts of the Sonora Institute and the BLM. This is the most current information available. The socioeconomic technical support document will be made available for review at the Rock Springs Field Office.

b. *Identify reasonable alternatives that should be evaluated once determined the level of analysis for the project.*

Two alternatives in chapter 2 were considered in detail; Proposed Action Alternative and No Action Alternative. The decision to include a description of other alternatives, section 2.1 page 2-1, were considered but not analyzed in detail, an option in an EA format (BLM Handbook H-1790-1) after preliminary investigation. In this case, the IDP does limit the range of reasonable alternatives considered, because its goal is to limit activity to only those areas where it is believed that significant adverse environmental impacts would not occur. The policy precludes the need for other development alternatives.

3. **Wyoming State Historic Preservation Office (SHPO)**

a. *Assure the project is conducted in accordance with Section 106 of the National Historic Preservation Act and Advisory Council regulations 36 CFR Part 800. These regulations require survey, evaluation and protection of significant historic and archeological sites* ***prior*** *to any disturbance.*

Section 2.1.11.2.15 Cultural Resources page 2-31 addresses primary mitigation activities.

b. *Provided the BLM follows the procedures established in the regulation, we have no objections to the project. Specific comments on the project's efforts on cultural resource sites will be provided to the BLM when we review the cultural resource documentation called for in 36 CFR Part 800.*

Thank you for your comments.

4. **Sweetwater County Board of County Commissioner**

a. *Strongly support the development of the Pacific Rim Project. Strongly encourage Warren E&P, Inc. to obtain all necessary permits and to develop this project in an environmentally sound manner.*

Encourage the BLM to work with the State of Wyoming and the oil and gas companies to ensure that water quality, quantity and disposal issues an are address in a manner that meet the present and future needs of Sweetwater County.

Section 2.2.1 Preconstruction Planning and Site Layout details permits and requirements necessary by the state and BLM for production within the PRPA.

b. *Community Infrastructure*
Address socio-economic data related to the cumulative effects of the existing and the proposed oil and gas field developments within the Rock Springs and Rawlins BLM Resources Area.

Some of the socio-economic issues that need to be assessed include: workforce demographics, housing, education, emergency services, health care, child care and others.

Local government officials and community leaders in Sweetwater County and Rock Springs are currently working to identify current and future impacts of natural gas-related growth on housing resources, on local facilities and services and on local government fiscal conditions (Gordon 2004). They plan to enlist State government and the natural industry in an effort to plan for and accommodate the industry-related growth (p. 5-25).
Also see response 2a.

5. **U.S. Department of Interior Fish and Wildlife Service (USFWS)**

a. *Bald Eagle: In order to reduce potential adverse effects to the bald eagle, a disturbance-free buffer zone of 1 mile should be maintained around eagle nests and winter roost sites. Activity within 1 mile of an eagle nest or roost may disturb the eagles and result in take. Activity should be conducted outside of February 15 through August 15 to protect nesting birds and November 1 through April 15 to protect roosting birds.*

Section 4.8.1.1.22 page 4-34 identifies a no effect to bald eagles. This type of habitat is not present on the project area, therefore, bald eagles are not expected to nest there. Bald eagles may utilize the project area during winter months when big game species are more concentrated on winter ranges. However, the area does not support concentrated use by bald eagles and bald eagle use of the project area is likely incidental. Therefore, the Proposed Action is not expected to impact bald eagles.

b. *Black-footed Ferret:* *Surveys are recommended even if only a portion of the town or complex will be disturbed.*

Section 4.8.1.1.22 page 4-34 indicates it is estimated that 37.3 acres of white-tailed prairie dog colonies would be disturbed under the Proposed Action. This amount of disturbance to prairie dog colonies would be a minor impact and would not result in significant effects upon the value of the colonies as potential future reintroduction sites. No impacts to black-footed ferrets would occur provided avoidance and mitigation measures outlined in this document and the RMP are implemented. Included in Appedix D is a copy of the black-footed ferret survey performed by Haden-Wing.

c. *Ute ladies'-tresses:* *A perennial, terrestrial orchid and blooms from late July through August, however, depending on location and climatic conditions , it may bloom in early July or still be in flower as late as early October. A survey should be conducted by a knowledgeable botanist.*

Section 4.8.1.1.4 page 4-35 addresses plant species. No suitable habitat for Ute ladies'-tresses occurs within the PRPS. The likelihood of Ute ladies'-tresses occurring on the PRPA is extremely low and no impacts to this species are expected under the Proposed Action.

d. *Consultation:* *Determine if a biological assessment is necessary, if so be in compliance of section 102 of NEPA and incorporate into the NEPA document. The Service would appreciate the opportunity to review any such determination document. If necessary, a BA should be completed within 180 days of receipt of a species list.*

Consultation between FWS and BLM was conducted and it was determined that there was ? ? ?

e. *Interrelated/Interdependent Effects:* *BLM should develop measures to avoid or minimize impact to listed species on non-Federal lands that would occur as a direct or indirect result of the project.*

Section 4.7.1 page 4-28 discusses direct and indirect impacts from the proposed action. No long-term adverse impacts are expected.

f. *<u>Yellow-billed Cuckoo:</u> The Cuckoo is a candidate for listing as threatened or endangered and may occur in riparian area west of the continental divided in Wyoming.*

Section 4.8.1.1.2 page 4-35 addresses the Yellow-billed Cuckoo and due to the lack of adequate habitat on the project area and the fact that no records of yellow-billed cuckoo are documented within six miles of the project area (WGFD 2003a, WYNDD 2003) it is unlikely that the yellow-billed cuckoo occurs on the project area. No adverse impacts to this species are expected from implementation of the Proposed Action.

g. *<u>Migratory Birds:</u> If nesting migratory birds are present on, or near the project area, timing is a significant consideration and needs to be addressed in the project planning.*

Consider sensitive species or species at risk in the project.

Section 4.7.1.1.4 page 4-33 indicates habitat for waterfowl and shorebirds is very limited in the project area. It is expected that the PRPA would not have significant impact.

Activity status of raptor nests will be checked prior to well development. If new raptor nest sites are located on the project area appropriate avoidance and mitigation measures would be taken to avoid significant impacts.

Although sensitive species have no legal protection under the ESA, the BLM and FWS still maintain an active interest under BLM Manual 6840.

h. *<u>Mountain Plover</u>: The Service has withdrawn the proposal for listing and we will no longer be reviewing project impacts to the species. The BLM is encouraged to continue providing protection for this species as under the MBTA.*

Section 4.8.2.1.2 page 4-37 indicated no mountain plover were recorded within the 6-mile buffer of the project area. No mountain plovers were observed on the PRPA during the surveys in the fall of 2003. If the species is located, no impacts to mountain plovers are expected provided that avoidance and mitigation measures outlined in this document and the RMP are implemented. Although sensitive species have no legal protection under the ESA, the BLM and FWS still maintain an active interest under BLM Manual 6840.

i. *<u>Sage Grouse</u>: Suggest BLM work with the local WY Game and Fish biologist to identify important sage grouse habitat with the project area, and appropriate mitigative measures to minimize potential impacts from the proposed project. No project activities that may exacerbate habitat loss or degradation should be permitted in important habitats.*

If important breeding habitat (leks, nesting or brood rearing habitat) is present in the project area, the USFWS recommends delaying the project until after July 31.

j. *<u>Wetland and Riparian Area</u>: Plans for mitigation unavoidable impacts to wetland and riparian areas should include mitigation goals and objectives, methodologies, time frames for implementation, success criteria, and monitoring to determine if the mitigation is successful. The mitigation plan should also include a contingency plan to be implemented should the mitigation not be successful.*

6. **Biodiversity Conservation Alliance**

a. *Propose project is slated for Roadless Lands Proposed for Wilderness Status. The propose project falls within the Kinney Rim North citizens proposed wilderness, which has wilderness qualities, recognized by the Citizens' Wilderness Inventory of the Kinney Rim North Unit.*

b. *Comment on project design, including but not limited to exact well locations, which in fact determine the overall environmental impact on various other lands uses and/or resources.*

c. *<u>Specific Concerns:</u>*
Cumulative impacts taking into consideration the oil and gas development on surrounding lands.

This analysis should address habitat fragmentation on a landscape scale, taking into account the overall ranges of individual wildlife populations (i.e., antelope herd population from the Bitter Creek Herd, sage grouse populations in the entire Red Desert).

*The effect the water withdrawals will have on the **4 species** (?**)** of endangered fishes downstream in the Colorado River system.*

How will produced water be disposed of?

d. *<u>Impacts on Wildlife:</u>*
Vehicle traffic with associated noise and dust.

Impacts on habitat use:

<u>Sage Grouse</u> and lek sites: Survey the project area for sage grouse leks, nesting and brood-rearing habitat occurs in the immediate vicinity of lek sites. No construction activities should be allowed within 2 miles of a lek site.

Survey for sage grouse wintering habitats: Stipulations prohibiting all human activities and noises (such as working pumps) suring the winter seasons.

Compressor stations: Facilities should not be built no closer than 2 miles from lek site.

<u>Raptor nesting;</u> Potential habitat for Ferruginous hawks, Golden eagles, Prairie falcons, and others.

Raptor nesting needs to be documented, and human activities must not occur within 2 miles of active nests during the nesting season.

<u>Mountain Plover:</u> Survey for nesting habitat during the brief period in spring when plovers are visible.

<u>White-tailed prairie dogs</u>: The impacts of the proposed project on prairie dogs and direct effects on the latter species must be studied.
Must consider impacts to other wildlife that may be found in the project area: Short-horned lizard, Pygmy rabbit, rare and declining shorebirds.

<u>Wild Horses</u>: Effects the project has on the horse and their area.

<u>Game Animals</u>:
Mule deer
Antelope
Crucial winter range; must be identified, on permanent facilities (roads or drilling pads) should be built. All human activities must be prohibited on such lands between November 15 through April 15.

Increase in salinity and sodicity associated with well-water discharge possibly damage to plant and animal life in the area.

Effects of the dewatering of aquifers must be adequately addressed.

Will this project cause springs in the area to dry up, particularly those that deed Vermillion Creek?

Will the dewatering of the target aquifer affect the season during which Vermillion Creek carries water over the long term?

Area should be surveyed for rare native plants and mitigation measures.

Shoshone, Comanche, and Ute tribes should be consulted regarding potential cultural and/or sacred significances of the project area.

EA should include all possible measures to prevent adverse environmental impacts due to toxic substances used and/or disposed.

Analysis of the possibility of subsidence and earthquakes due to ground water drawndown and degasification of the target strata.

Disclose the extent of hydraulic fracturing inherent to the project, nor the effects of toxic fracing fluids on groundwater or other resources, to satisfy NEPA "hard look" requirements

***Reclamation**; the use of native species for reseeding purposes. Soil potential for revegetation must be evaluated.*

Effects of the project on biological soil crusts. These soil crusts, consisting of bryophytes, cyanobactieria, fungi and lichens, and mosses, fulfill a role in desert ecosystem.

Require a 500-foot buffer for vegetation, between surface disturbances and drainage channels, playas, and wetlands. Requirements to avoid stream channels and riparian vegetation need to be ironclad.

All reserve pits must always be lined with impermeable fabric, because they will contain hazardous chemicals.

All reserve pit contents should be carefully removed by operator and disposed of at a site built specifically to handle toxic waste.

***Alternative:** The use of "pitless drilling" techniques, which entail closed-loop systems for drilling fluids and therefore don't require reserve pits, should be analyzed in detail; we urge their use for all wells.*

The need to employ directional drilling technologies to reduce environmental impacts of mineral development is a high priority of the Bush administration.

Cluster drilling from a single well pad (French Oil and Gas Association 1990) can reduce the footprint of oil and gas development on the landscape by concentrating the activity and impacts of many wells at a few widely dispersed sites.

Directional drilling, in its several forms, has been shown to be remarkably versatile as an alternative to conventional vertical drilling in recovery.

Directional drilling is also applicable to coalbed methane production, but drilling rig placement may be constrained by rock jointing and fracture

patterns (Moore and Moore 1999). O'Rourke et al. (1997) found horizontal drilling of paired wells to be effective in gas production using steam injection techniques.

Directional drilling is proven as an effective alternative to vertical drilling in Wyoming. Even if the costs of directional drilling are higher for the project, the BLM should require the project proponent to employ this method.

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

1. Well Pad and Road Construction Emissions (Dozer and Backhoe)

Assumptions:

Well Pad and Road Area	2.30	acres (Proposed Action)
Hours of Construction	4	days per well pad (Proposed Action)
	8	hours/day
	32	hours per well pad
Watering Control Efficiency	50	percent (Recommended by Wy DEQ)
Soil Moisture Content	7.9	percent (AP-42 Table 11.9-3, 10/98)
Soil Silt Content	6.9	percent (AP-42 Table 11.9-3, 10/98)
PM10 Multiplier	0.75 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.105 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs/hr) = 5.7 * (soil silt content %)^1.2 * (soil moisture content %)^-1.3* Control Efficiency

Emissions (PM15 lbs/hr) = 1.0 * (soil silt content %)^1.5 * (soil moisture content %)^-1.4 * Control Efficiency

Emissions = 1.97 lbs TSP/hour/piece of equipment

Emissions = 0.50 lbs PM15/hour/piece of equipment

	Dozer and Backhoe Emissions [a]		
	lbs/hr	**tons/well**	**tons/yr [b]**
TSP	3.94	0.0631	4.10
PM15	1.00	0.0161	1.04
PM10	0.75	0.0120	0.78
PM2.5	0.41	0.0066	0.43

a Assumes one dozer and one backhoe. Backhoe emissions are conservatively estimated as equivalent to Dozer emissions.

b Assumes a construction rate of 65 wells per year over two years

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

2. Well Pad and Road Construction Emissions (Grader)

Assumptions:

Road Length	0.33	miles (Proposed Action)
Hours of Construction	4	days per well pad (Proposed Action)
	8	hours/day
	32	hours per well pad
Watering Control Efficiency	50	percent (Recommended by Wy DEQ)
Average Grader Speed	10	mph (Typical value)
Distance Graded	1.32	miles (2 round trips on road)
PM10 Multiplier	0.6 * PM15	(AP-42 Table 11.9-1, 10/98)
PM2.5 Multiplier	0.031 * TSP	(AP-42 Table 11.9-1, 10/98)

Equations: From AP-42 tables 11.9-1 and 11.9-3 for
Bulldozing Overburden Emissions, Western Surface Coal Mining, 10/98

Emissions (TSP lbs) = 0.040 * (Mean Vehicle Speed)$^{2.5}$ * Distance Graded * Control Efficiency

Emissions (PM15 lbs) = 0.051 * (Mean Vehicle Speed)$^{2.0}$ * Distance Graded * Control Efficiency

Emissions = 8.35 lbs TSP/well

Emissions = 3.37 lbs PM15/well

	Grader Construction Emissions			
	lbs/well	**lbs/hr**	**tons/well**	**tons/yr [a]**
TSP	8.35	0.26	0.0042	0.27
PM15	3.37	0.11	0.0017	0.11
PM10	2.02	0.06	0.0010	0.07
PM2.5	0.26	0.01	0.0001	0.01

b Assumes a construction rate of 65 wells per year over two years

Buys & Associates, Inc. Environmental Consultants	Project: Pacific Rim Emission Inventory Date: 3/11/2004

3. Construction Traffic Fugitive Dust Emissions

Assumptions:

Average Round Trip Distance	12	miles (Estimated from Project Area and existing road system)
Hours of Construction	32	hours per site (Proposed Action)
Watering Control Efficiency	50	percent (Wy DEQ Recommendation)
Road Silt Content	5.1	percent (AP-42 Table 13.2.2-1, 9/98)
Road Moisture	0.2	percent (Default Value, AP-42 Section 13.2.2, 9/98)

Equation: From AP-42 13.2.2, Unpaved Roads, 9/98

$$\text{E Size Spec. Factor (lb/VMT)} = \frac{k * (s/12)^a * (W/3)^b * \text{Control Efficiency}}{(M/0.2)^c}$$

Where k, a, b, and c are empirical constants listed below and

E = size-specific emission factor (lbs/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
M = surface material moisture content (%)

Empirical Constants			
Constant	**PM2.5**	**PM10**	**PM30/TSP**
k	0.38	2.6	10.0
a	0.8	0.8	0.8
b	0.4	0.4	0.5
c	0.3	0.3	0.4

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

4. Construction Traffic Fugitive Dust Emissions continued

Vehicle Type	Ave. Weight (lbs)	Round Trips per Well	Hours Per Activity	Controlled Emission Factors (lbs/VMT)			TSP Emissions		PM10 Emissions		PM2.5 Emissions	
				TSP	PM10	PM2.5	Max. lb/hr	Tons/well	Max. lb/hr	Tons/well	Max. lb/hr	Tons/well
Construction Activities												
Semi: Hvy Equip Hauler	74,000	3										
Haul Truck:Gravel	48,000	4										
Pickup Truck: Crew	7,000	4										
Construction Total	40,182	11	32	6.53	1.40	0.21	26.92	0.43	5.79	0.09	0.85	0.01
Drilling Activities												
Semi: Rig Transport	60,000	6										
Haul Truck:Fuel	48,000	5										
Haul Truck: Mud	48,000	2										
Haul Truck: Water	20,000	20										
Haul Truck: Supplies	48,000	2										
Logging Trucks	48,000	4										
Pickup Truck: Rig Crew	7,000	20										
Pickup Truck: Mechanic	8,000	6										
Pickup Truck: Supervisor	7,000	10										
Pickup Truck: Mud Logger	8,000	10										
Pickup: Bit/Tool Delivery	8,000	2										
Pickup: Mud Engineer	7,000	2										
Total Drilling	19,685	89	240	4.57	1.05	0.15	20.33	2.44	4.69	0.56	0.69	0.08
Completion Activities												
Semi: Casing	74,000	3										
Cement Haul Trucks	74,000	2										
Cement Pump Truck	48,000	2										
Completion Rig	74,000	1										
Completion Rig Equip Truck	48,000	3										
Frac Trucks	80,000	3										
Haul: Tanks	48,000	3										
Haul: Sand	44,000	3										
Haul: Chemicals	44,000	3										
Logging/Perf. Truck	48,000	3										
Pickup: Comp.Foreman	7,000	3										
Pickup: Casing Crews	7,000	3										
Pickup: Cement Crew	8,000	2										
Pickup: Completion Rig Crew	7,000	3										
Pickup: Logging/Perf Crew	7,000	3										
Pickup: Frac Crew	7,000	3										
Pickup: Consultants	7,000	3										
Total Completion	35,174	46	24	6.11	1.33	0.19	140.42	1.69	30.59	0.37	4.47	0.05
Field Development												
Gathering Sys. Const. Crew	8,000	4										
Haul Truck: Trencher	48,000	4										
Haul Truck: Pipe	48,000	4										
Surveyor	7,000	4										
Welder	8,000	4										
Reclamation Crew	8,000	4										
Total Field Development	21,167	24	16	4.74	1.09	0.16	85.25	0.68	19.54	0.16	2.86	0.02
Total Well Traffic Emissions (per/well)							272.92	5.24	60.61	1.18	8.86	0.17
Annual Traffic Emissions (Tons/year for 65 wells)								340.39		76.64		11.20

Buys & Associates, Inc. Environmental Consultants	Project: Pacific Rim Emission Inventory Date: 3/11/2004

5. Wind Erosion Fugitive Dust Emissions

Assumptions

Threshold Friction Velocity U_t*	1.02	m/s (2.28 mph) for well pads (AP-42 Table 13.2.5-2 Overburden - Western Surface Coal Mine
	1.33	m/s (2.97 mph) for roads (AP-42 Table 13.2.5-2 Roadbed material)
Initial Disturbance Area	144.0	acres total initial disturbance for roads(Proposed Action)
	582,746	square meters total initial disturbance for roads
	354	acres total initial disturbance for wells, compressors, and pipelines (Proposed Action)
	1,430,561	square meters total initial disturbance for well, compressors and pipelines
	498	acres total disturbance
Exposed Surface Type	Flat	
Meteorological Data	2002	Rock Springs Airport (obtained from NCDC website)
Fastest Mile Wind Speed U_{10}^+	24.1	meters/sec (54 mph) reported as fastest 2-minute wind speed for Rock Springs
Number soil of disturbances	2	for well pads and pipelines (Assumption, disturbance at construction and reclamation)
	Constant	for dirt roads
Development Period	2	years (Proposed Action)

Equations

Friction Velocity $U^* = 0.053\ U_{10}^+$

Erosion Potential P (g/m^2/period) = $58*(U^*-U_t^*)^2 + 25*(U^*-U_t^*)$ for $U^*>U_t^*$, P = 0 for $U^*< U_t^*$

Emissions (tons/year) = Erosion Potential(g/m^2/period)*Disturbed Area(m^2)*Disturbances/year*(k)/(453.6 g/lb)/2000 lbs/ton/Develop Period

Particle Size Multiplier (k)		
30 um	<10 um	<2.5 um
1.0	0.5	0.2

Maxium U_{10}^+ Wind Speed (m/s)	Maximum U* Friction Velocity m/s	Well/Pipeline U_t* Threshold Velocity[a] m/s	Well Pad Erosion Potential g/m^2	Road U_t* Threshold Velocity[a] m/s	Road Erosion Potential g/m^2
24.10	1.28	1.02	10.27	1.33	0.00

Wind Erosion Emissions

Particulate Species	Wells/Pipelines (tons/year)	Roads (tons/year)
TSP	16.20	0.00
PM10	8.10	0.00
PM2.5	3.24	0.00

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

6. Construction Tailpipe Emissions

Assumptions:

Average Round Trip Distance	12.0	miles (Estimated from project area and existing road system)
Hours of Construction	32	hours per site (4 days @ 8 hrs/day - Proposed Action)
Number of Heavy Diesel Truck Trips	7	(Proposed Action)
Number of Pickup Trips	4	(Proposed Action)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Construction Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions
	(g/mile)	(lb/hr)	(tons/yr/well)	(g/mile)	(lb/hr)	(tons/yr/well)	(lb/hr)	(tons/yr)
NOx	8.13	0.047	0.001	3.03	0.010	0.000	0.057	0.059
CO	17.09	0.099	0.002	33.64	0.111	0.002	0.210	0.219
VOC [c]	4.83	0.028	0.000	1.84	0.006	0.000	0.034	0.035
SO2	0.32	0.002	0.000	0.21	0.001	0.000	0.003	0.003

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes a construction rate of 65 wells per year over two years

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Environmental Consultants

Project: Pacific Rim Emission Inventory
Date: 3/11/2004

7. Drilling Tailpipe Emissions

Assumptions:

Average Round Trip Distance	12.0	miles (Estimated from project area and existing road system)
Hours of Operation	240	hours per site (10 days @ 24 hrs/day - Proposed Action)
Number of Heavy Diesel Truck Trips	39	(Proposed Action)
Number of Pickup Trips	50	(Proposed Action)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Drilling Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions
	(g/mile)	(lb/hr)	(tons/yr/well)	(g/mile)	(lb/hr)	(tons/yr/well)	(lb/hr)	(tons/yr)
NOx	8.13	0.035	0.004	3.03	0.017	0.002	0.052	0.403
CO	17.09	0.073	0.009	33.64	0.185	0.022	0.259	2.019
VOC [c]	4.83	0.021	0.002	1.84	0.010	0.001	0.031	0.241
SO2	0.32	0.001	0.000	0.21	0.001	0.000	0.003	0.020

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes a construction rate of 65 wells per year over two years

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

8. Completion Tailpipe Emissions

Assumptions:

Average Round Trip Distance	12.0	miles (Estimated from project area and existing road system)
Hours of Operation	24	hours per site (3 days @ 8 hrs/day - Assumption)
Number of Heavy Diesel Truck Trips	26	(Proposed Action)
Number of Pickup Trips	20	(Proposed Action)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * 453.6\ \text{(g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Completion Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions
	(g/mile)	(lb/hr)	(tons/yr/well)	(g/mile)	(lb/hr)	(tons/yr/well)	(lb/hr)	(tons/yr)
NOx	8.13	0.233	0.003	3.03	0.067	0.001	0.300	0.234
CO	17.09	0.490	0.006	33.64	0.742	0.009	1.231	0.961
VOC [c]	4.83	0.138	0.002	1.84	0.041	0.000	0.179	0.140
SO2	0.32	0.009	0.000	0.21	0.005	0.000	0.014	0.011

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes a construction rate of 65 wells per year over two years

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

9. Development Tailpipe Emissions

Assumptions:

Average Round Trip Distance	12.0	miles (Estimated from project area and existing road system)
Hours of Operation	16	hours per site (2 days @ 8 hrs/day - Assumption)
Number of Heavy Diesel Truck Trips	4	(Assumption)
Number of Pickup Trips	3	(Assumption)
Diesel Fuel sulfur content	0.05	% (Typical value)
Diesel Fuel density	7.08	lbs/gallon (Typical value)
Heavy Haul Diesel Fuel Efficiency	10	miles/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{\# Trips} * \text{Trip Distance (miles)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Development Vehicles	Heavy Haul Trucks			Heavy Duty Pickups			Total [d]	
	E. Factor [a]	Emissions	Emissions	E. Factor [b]	Emissions	Emissions	Emissions	Emissions
	(g/mile)	(lb/hr)	(tons/yr/well)	(g/mile)	(lb/hr)	(tons/yr/well)	(lb/hr)	(tons/yr)
NOx	8.13	0.054	0.000	3.03	0.015	0.000	0.069	0.036
CO	17.09	0.113	0.001	33.64	0.167	0.001	0.280	0.146
VOC [c]	4.83	0.032	0.000	1.84	0.009	0.000	0.041	0.021
SO2	0.32	0.002	0.000	0.21	0.001	0.000	0.003	0.002

a AP-42 Table 7.1.2 - H.D. Diesel Powered Vehicles, High Altitude, 1991 - 1997 Model Year, 50,000 miles (6/95)
b AP-42 Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
c Emission factor is for total Hydrocarbons.
d Assumes a construction rate of 65 wells per year over two years

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

10. Construction Heavy Equipment Tailpipe Emissions

Assumptions:

Hours of Operation	32 hours/site (4 days @ 8 hrs/day - Proposed Action)
Development Rate	65 wells per year (Proposed Action)
Load Factor	0.4 (Assumed typical value)
Backhoe Size	100 hp (Assumed Typical value)
Dozer Size	150 hp (Assumed Typical value)
Motor Grader Size	135 hp (Assumed Typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Rated Horsepower (hp)} * \text{Operating Hours (hrs)} * \text{Load Factor (Dimensionless)}}{453.6\ \text{(g/lb)} * 2000\ \text{(lb/tons)}}$$

Heavy Const. Vehicles	Backhoe			Dozer			Grader		
	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [a] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)	E. Factor [b] (g/hp-hr)	Emissions (lb/hr)	Emissions[e] (tons/yr)
NOx	8.15	0.719	0.747	8.15	1.078	1.121	7.14	0.850	0.884
CO	2.28	0.201	0.209	2.28	0.302	0.314	1.54	0.183	0.191
VOC [c]	0.37	0.033	0.034	0.37	0.049	0.051	0.36	0.043	0.045
PM10 [d]	0.5	0.044	0.046	0.5	0.066	0.069	0.63	0.075	0.078
PM2.5 [d]	0.5	0.044	0.046	0.5	0.066	0.069	0.63	0.075	0.078
SO2	0.22	0.019	0.020	0.22	0.029	0.030	0.22	0.026	0.027
Formaldehyde	0.22	0.019	0.020	0.22	0.029	0.030	0.12	0.014	0.015

Heavy Const. Vehicles	Total	
	Emissions (lb/hr)	Emissions[e] (tons/yr)
NOx	2.647	2.753
CO	0.686	0.713
VOC [c]	0.124	0.129
PM10 [d]	0.185	0.193
PM2.5 [d]	0.185	0.193
SO2	0.075	0.078
Formaldehyde	0.063	0.065

a AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Off-highway truck
b AP-42 Volume II, Mobile Sources, Nonroad Vehicles, Table 11-7.1 Motor Grader
c Emission Factor represents total Hydrocarbon Emissions
d All emitted particulate matter assumed to be PM2.5
e Assumes a construction rate of 65 wells per year over two years

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Project: Wind River Proposed Action Inventory
Date: 3/11/2004

11. Pumper Tailpipe Emissions

Assumptions:

Number of New Pumpers:	4	(Assumption)
Pumper Mileage:	1,000	miles/pumper/month (Assumption)
Total Annual New Pumper Mileage:	48,000	miles/year
Hours of Pumper Operation:	8	hours per day (Assumption)
Hours of Pumper Operation:	2080	hours per year
Fuel sulfur content	0.05	% (Typical value)
Fuel density	7.08	lbs/gallon (Typical value)
Heavy Duty Pickup Fuel Efficiency	15	miles/gallon (Typical value)

Equations:

For NOx, CO and VOC:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (g/mile)} * \text{Vehicle Miles Traveled (miles/yr)}}{\text{453.6 (g/lb)} * \text{2000 (lb/tons)}}$$

The NOx, CO and VOC emission factors for the above equation are from AP-42, while the SO2 emissions are calculated on a mass balance basis utilizing the following equation:

$$\text{SO2 E. Factor (g/mi)} = \frac{\text{Fuel Density (lb/gal)} * \text{453.6 (g/lb)} * \text{Fuel Sulfur Content} * 2\ (S / SO2)}{\text{Vehicle Fuel Efficiency (miles/gal)}}$$

Pumper Vehicles	Heavy Duty Pickups		
	E. Factor [a] (g/mile)	Emissions (lb/hr)	Emissions (tons/yr)
NOx	3.03	0.154	0.160
CO	33.64	1.711	1.780
VOC [b]	1.84	0.094	0.097
SO2	0.21	0.011	0.011

a AP-42 Append H Table 4.1A.2 - H.D. Gasoline Vehicles, High Altitude, 1991 - 1997 Vehicle Year, 50,000 miles (6/95)
b Emission factor is for total Hydrocarbons.

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

12. Drill Rig Engine Emissions

Assumptions:

Hours of Operation	240	hours/well (10 days @ 24 hrs/day - Assumption)
Development Rate	65	wells/year (Proposed Action)
Load Factor	0.4	(Assumed typical value)
Rig Size	1200	hp (Assumption)
Diesel Fuel Sulfur Content	0.05	% (typical value)

Equations:

$$\text{Emissions (tons/year)} = \frac{\text{Emission Factor (lb/hp-hr) * Rated Horsepower (hp)* Operating Hours (hrs) * Load Factor (Dimensionless)}}{\text{2000 (lb/tons)}}$$

SO2 E. Factor (lb/hp-hr) = Fuel sulfur content * 0.00809

Species	Drill Rig Emissions		
	E. Factor [a]	Emissions	Emissions [e]
	(lb/hp-hr)	(lb/hr)	(tons/yr)
NOx	0.024	11.520	89.856
CO	0.0055	2.640	20.592
VOC [b]	0.000705	0.338	2.640
PM10 [c]	0.000573	0.275	2.145
PM2.5 [d]	0.000479	0.230	1.793
SO2	0.0004045	0.194	1.514

a AP-42 Volume I, Large Stationary Diesel Engines Table 3.4-1, 10/96
b Emission Factor represents total Hydrocarbon Emissions
c Total particulate emission factor is 0.0007, PM10 fraction determined from Table 3.4-2
d Total particulate emission factor is 0.0007, PM2.5 fraction determined from Table 3.4-2
e Assumes a construction rate of 65 wells per year over two years

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PRPA
3/11/2004

13. Average Produced Gas Composition
(Almond Formation Sample 2/18/03 - Nearby CBM Project)

COMPONENT	Average Gas Composition Mole %
Carbon Dioxide	1.7793
Oxygen	
Hydrogen Sulfide	
Nitrogen	1.5041
Methane	95.4475
Ethane	0.8821
Propane	0.2754
Isobutane	0.0605
n-Butane	0.0339
Isopentane	0.0106
n-Pentane	0.0050
Hexanes	0.0017
Heptanes	
C-8 + Heavies	
Benzene	
Toluene	
Ethylbenzene	
Xylenes	
TOTAL	100.000

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

14. Average Produced Gas Characteristics (Almond Formation Sample 2/18/03 - Nearby CBM Field)

Gas Heat Value (wet): 974 Btu/scf

C1-C2 Wt. Fraction: 0.918
VOC Wt. Fraction: 0.011
Non-HC Wt. Fraction: 0.071
Total: 1.000

COMPONENT	MOLE PERCENT	COMPONENT MOLE WEIGHT (lb/lb-mole)	NET MOLE WEIGHT (lb/lb-mole)	WEIGHT FRACTION	GROSS HEATING VALUE (BTU/scf)	NET DRY HEATING VALUE (BTU/scf)	LOWER HEATING VALUE (BTU/scf)	NET LOW HEATING VALUE (BTU/scf)
Methane	95.4475	16.043	15.313	0.902	1010.000	964.020	910.000	868.572
Ethane	0.8821	30.070	0.265	0.016	1769.800	15.611	1618.000	14.272
Propane	0.2754	44.097	0.121	0.007	2516.200	6.930	2316.000	6.378
i-Butane	0.0605	58.123	0.035	0.002	3252.100	1.968	3005.000	1.818
n-Butane	0.0339	58.123	0.020	0.001	3262.400	1.106	3013.000	1.021
i-Pentane	0.0106	72.150	0.008	0.000	4000.900	0.424	3698.000	0.392
n-Pentane	0.0050	72.150	0.004	0.000	4008.800	0.200	3708.000	0.185
Hexanes+	0.0017	86.177	0.000	0.000	4756.200	0.000	4404.000	0.000
Heptanes		100.204	0.000	0.000	5502.500	0.000	5100.000	0.000
Octanes		114.231	0.000	0.000	6249.100	0.000		0.000
Nonanes		128.258	0.000	0.000	6996.400	0.000		0.000
Decanes		142.285	0.000	0.000	7743.200	0.000		0.000
Benzene		78.120	0.000	0.000	3715.500	0.000		0.000
Toluene		92.130	0.000	0.000	4444.600	0.000		0.000
Ethylbenzene		106.160	0.000	0.000	5191.500	0.000		0.000
Xylenes		106.160	0.000	0.000	5183.500	0.000		0.000
n-Hexane		86.177	0.001	0.000	4756.200	0.081		0.000
Helium		4.003	0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	1.5041	28.013	0.421	0.025	0.000	0.000	0.000	0.000
Carbon Dioxide	1.7793	44.010	0.783	0.046	0.000	0.000	0.000	0.000
Oxygen		32.000	0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide		34.080	0.000	0.000	637.100	0.000	588.000	0.000
TOTAL	100.000		16.971	1.000		990.340		892.640

Relative Mole Weight (lb/lb-mole) = [Mole Percent * Molecular weight (lb/lb-mole)] / 100

Weight Fraction = Net Mole Weight / Total Mole Weight

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Project: Pacific Rim Emission Inventory
Date: 3/15/2004

15. Vented Gas Emissions

Assumptions

Amount of Gas Vented 50 Mscfd/well for 5 days (Assumption - Nearby CBM Project)

Equations

Relative Mole Weight (lb/lb-mole) = [Molecular Weight (lb/lb-mole) * Mole Percent] / 100

Weight Percent = Relative Mole Weight * 100 / Total Relative Mole Weight

Component Flow Rate (Mscf/day) = [Flow Rate (Mscf/day) * Mole Percent] / 100

Component Flow Rate (lb/hr) = $\frac{\text{Component Flow (Mscf/day) * 1,000 scf/Mscf * Molecular Weight (lb/lb-mole)}}{\text{24 hours/day * 379.49 scf/mole}}$

Component Flow Rate (tons/well) = Component Flow (lb/hr/well) * 5 days * 24 hours/day

Component Flow Rate (tons/yr) = Component Flow (tons/well) * 60 gas wells per year

Vent Rate = 50 Mscf/day

COMPONENT	MOLECULAR WEIGHT (lb/lb-mole)	MOLE PERCENT	RELATIVE MOLE WEIGHT (lb/lb-mole)	WEIGHT PERCENT	COMPONENT FLOW RATE (Mscf/day)	COMPONENT FLOW RATE (lb/hr/well)	COMPONENT FLOW RATE (tons/well)	COMPONENT FLOW RATE (tons/year)
Methane	16.043	95.448	15.313	90.227	47.724	84.064	5.044	302.629
Ethane	30.070	0.882	0.265	1.563	0.441	1.456	0.087	5.242
Propane	44.097	0.275	0.121	0.716	0.138	0.667	0.040	2.400
i-Butane	58.123	0.061	0.035	0.207	0.030	0.193	0.012	0.695
n-Butane	58.123	0.034	0.020	0.116	0.017	0.108	0.006	0.389
i-Pentane	72.150	0.011	0.008	0.045	0.005	0.042	0.003	0.151
n-Pentane	72.150	0.005	0.004	0.021	0.003	0.020	0.001	0.071
Hexanes	86.177	0.002	0.001	0.009	0.001	0.008	0.000	0.029
Heptanes	100.204		0.000	0.000	0.000	0.000	0.000	0.000
Octanes	114.231		0.000	0.000	0.000	0.000	0.000	0.000
Nonanes	128.258		0.000	0.000	0.000	0.000	0.000	0.000
Decanes +	142.285		0.000	0.000	0.000	0.000	0.000	0.000
Benzene	78.120		0.000	0.000	0.000	0.000	0.000	0.000
Toluene	92.130		0.000	0.000	0.000	0.000	0.000	0.000
Ethylbenzene	106.160		0.000	0.000	0.000	0.000	0.000	0.000
Xylenes	106.160		0.000	0.000	0.000	0.000	0.000	0.000
n-Hexane	86.177		0.000	0.000	0.000	0.000	0.000	0.000
Helium	4.003		0.000	0.000	0.000	0.000	0.000	0.000
Nitrogen	28.013	1.504	0.421	2.483	0.752	2.313	0.139	8.327
Carbon Dioxide	44.010	1.779	0.783	4.614	0.890	4.299	0.258	15.476
Oxygen	32.000		0.000	0.000	0.000	0.000	0.000	0.000
Hydrogen Sulfide	34.080		0.000	0.000	0.000	0.000	0.000	0.000
VOC SUBTOTAL		**0.387**	**0.189**	**1.114**	**0.194**	**1.038**	**0.062**	**3.736**
HAP SUBTOTAL		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
TOTAL		**100.000**	**16.971**	**100.000**	**50.000**	**93.170**	**5.590**	**335.411**

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

16. Central Station TEG Dehydrator Emissions

Assumptions

Production Rate: 0.4 MMscf/day per well
(Assumption - Nearby CBM Project)

Gas Composition: One sample dated 2/18/2003 was utilized
(Almond Formation - Nearby CBM Project)

Inlet Gas Conditions: Inlet gas was assumed to be saturated at 800 psi and 80 F
(Assumption - Nearby CBM Project)

Glycol Circulation Rate: 3 gallons/ lb of water
(Typical operating rate)

Calculations

Dehydrator emissions were simulated using GRI GlyCalc version 4.0

Emissions

Species	Central Dehydrator Emissions [a] (tons/year)	Total Project Emissions [b] (tons/year)
VOC	0.51	2.54
Benzene	0.00	0
Toluene	0.00	0
Ethylbenzene	0.00	0
Xylenes	0.00	0
n-Hexane	0.00	0
Total HAPs	0.00	0

a Assumes each central station processes 9.6MMscf/day gas
(Assumption - Nearby CBM Project well production rate)
b Assumes five central stations process a total of 48MMscf/day gas
(Required number of stations and dehydrators based on Proposed Action, assumes equal gas volume distribution)

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Project: Pacific Rim Emission Inventory
3/11/2004

17. Central Dehydrator Reboiler Emissions

Assumptions

Central Dehydrator Reboiler Size	1000	MBTU/hr (Assumption based on exisitng permitted equipment)
Firing Rate	8760	hours/year (Typical Value)
Fuel Gas Heat Content	893	Btu/scf (Almond Formation - Nearby CBM Project)
Fuel Gas VOC Content	0.011	by weight (Almond Formation - Nearby CBM Project)
Number of Dehydrators	5	(Proposed Action)

Equations

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MBtu/hr)} * 1{,}000\ \text{(Btu/MBtu)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * 1{,}000{,}000\ \text{(scf/MMscf)}}$$

$$\text{NOx/CO/TOC Emissions (tons/yr)} = \frac{\text{AP-42 E.Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)} * \text{Fuel heating Value (Btu/scf)}}{2{,}000\ \text{(lbs/ton)} * 1{,}000\ \text{(Btu/scf - Standard Fuel Heating Value)}}$$

$$\text{VOC Emissions (tons/yr)} = \text{TOC Emissions (tons/yr)} * \text{VOC wt. fraction}$$

	Dehydrator Reboiler Emissions		
	Emission Factor (lb/MMscf)	Dehy Emissions (lb/hr/dehy)	Total Emissions [e] (tons/yr)
NOx [a]	94	0.094	2.059
CO [a]	40	0.040	0.876
TOC [c]	11	0.011	0.241
VOC	N.A.	0.000	0.003
SOx [b]	0.00	0.000	0.000
TSP [c]	7.6	0.008	0.166
PM10 [c]	7.6	0.008	0.166
PM2.5 [c]	7.6	0.008	0.166
Benzene [d]	0.0021	0.000	0.000
Toluene [d]	0.0034	0.000	0.000
Hexane [d]	1.8	0.002	0.039
Formaldehyde [d]	0.075	0.000	0.002

a AP-42 Table 1.4-1, Emission Factors for Natural Gas Combustion, 2/98
b Assumes produced gas contains no sulfur
c AP-42 Table 1.4-2, Emission Factors for Natural Gas Combustion, 3/98 (All Particulates are PM1.0)
d AP-42 Table 1.4-3, Emission Factors for Organic Compounds from Natural Gas Combustion, 3/98
e Total heater emissions for project assuming full development of all wells

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

18. Gas Compression and Processing

Assumptions:

Gas Compression Power: 11,500 Horsepower (Proposed Action)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr)
NOx [1]	1.5	38.03	166.6
CO [1]	0.5	12.68	55.5
VOC [1]	1.0	25.35	111.0
Formaldehyde [1]	0.07	1.77	7.8

1 - Emission rates based on Caterpillar 3516LE lean-burn natural gas-fired compressor engine with oxidation catalyst. (Assumption based on existing permitted equipment)

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Project: Pacific Rim Emission Inventory
Date: 3/15/2004

19. Generator Engine Sources

Assumptions:

Power Requirement: 3,900 Horsepower
(30 hp per well @130 wells - Assumption from nearby CBM Project)

Equations:

$$\text{Emissions (lbs/hr)} = \frac{\text{Emission Factor (g/hp-hr)} * \text{Power (hp)}}{453.6 \text{ g/lb}}$$

Pollutant	Emission Factor (g/hp-hr)	Emissions (lb/hr)	Emissions (tons/yr)
NOx [1]	1.0	8.60	37.7
CO [1]	1.0	8.60	37.7
VOC [1]	1.0	8.60	37.7
Formaldehyde [1]	0.05	0.43	1.9

1 - Emission rates based on Caterpillar G3516SITA rich-burn natural gas-fired generator engine with AFRC/NSCR. (Assumption based on existing permitted equipment)

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

20. Maximum Short-Term Construction Emission Summary

Pollutant	Short-Term Construction Emissions (lb/hr/well)					Wind Erosion	Max. Total (lb/hr/well)
	Construction	Drilling	Completion	Development	Maximum		
NO_X	2.70	11.57	0.30	0.07	11.57		11.57
CO	0.90	2.90	1.23	0.28	2.90		2.90
VOC	0.16	0.37	1.22	0.04	1.22		1.22
SO_2	0.08	0.20	0.01	0.00	0.20		0.20
PM_{10}	6.79	4.97	30.59	19.54	30.59	0.04	30.63
$PM_{2.5}$	1.45	0.92	4.47	2.86	4.47	0.02	4.49
Benzene							
Toluene							
Ethylbenzene							
Xylene							
n-Hexane							
Formaldehyde	0.06				0.06		0.06

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

21. Long-Term Construction Emissions Sumary

Pollutant	Long-Term Construction Emissions (tons/year) [a]				Wind Erosion	Total (tons/yr)
	Construction	Drilling	Completion	Development		
NO_X	2.81	90.26	0.23	0.04		93.34
CO	0.93	22.61	0.96	0.15		24.65
VOC	0.16	2.88	3.88	0.02		6.94
SO_2	0.08	1.53	0.01	0.00		1.63
PM_{10}	5.21	38.75	23.86	10.16	8.10	86.08
$PM_{2.5}$	1.24	7.14	3.49	1.49	3.24	16.60
Benzene						
Toluene						
Ethylbenzene						
Xylene						
n-Hexane						
Formaldehyde	0.07					0.07

a - Assumes a well development rate of 65 wells per year for two years

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Project: Pacific Rim Emission Inventory
Date: 3/15/2004

22. Total Project Production Related Emissions Summary

Pollutant	Total Project Production Emissions (tons/year)				Total Production (tons/year)
	Dehydrators	Generator Engines	Pumper Vehicle	Central Compression	
NO_X	2.06	37.66	0.16	166.57	206.45
CO	0.88	37.66	1.78	55.52	95.84
VOC	2.54	37.66	0.10	111.04	151.34
SO_2			0.01		0.01
PM_{10}	0.17				0.17
$PM_{2.5}$	0.17				0.17
Benzene					0.00
Toluene					0.00
Ethylbenzene					0.00
Xylene					0.00
n-Hexane					0.00
Formaldehyde		1.88		7.77	9.66

Assumes 120 gas wells are producing 48 MMscf/day of gas

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

23. Total Project Emissions Summary

Pollutant	Project Emissions (tons/year)				Total Emissions (tons/year)
	Well Development	Well Production	Well Subtotal	Gas Compression and Dehydration	
NO_X	93.3	37.8	131.2	168.6	299.8
CO	24.6	39.4	64.1	56.4	120.5
VOC	6.9	37.8	44.7	113.6	158.3
SO_2	1.6	0.0	1.6	0.0	1.6
PM_{10}	86.1	0.0	86.1	0.2	86.2
$PM_{2.5}$	16.6	0.0	16.6	0.2	16.8
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	1.9	1.9	7.8	9.7

Assumes previously specified development and production rates

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Project: Pacific Rim Emission Inventory
Date: 3/11/2004

24. Existing Permitted Source Emission Summary

Company	Facility	UTM Easting (m)	UTM Northing (m)	Approximate Distance to PRPA (km)	Estimated Annual Emissions (tons/year)	
					NO_x	CO
Wexpro Company	Canyon Creek/Vermillion Complex	688400	4547700	15	134.0	195.7
Pamco Services International Incorporated[1]	Compressor CT-1215 (Canyon Creek)	700319	4553962	17	17.4	17.4
Questar Gas Management Company	Big Drop Compressor Station	701200	4554000	18	3.9	3.9
Total Emissions					**155.2**	**217.0**

[1]Estimated UTM Coordinates

Includes all significant sources within 20 km of PRPA Center (Source: WDEQ)
Excludes well production sources with emissions < 2 tons per year

APPENDIX A-2: IMPROVE MODEL RESULTS

For comparison, reconstructed background seasonal extinction values for 1988-2002 based on data collected as part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program for Bridger Wilderness were applied in a separate analysis (IMPROVE 2003). The following table summarizes the results utilizing the IMPROVE background data. A total of two days exceeding 0.5 Δ dv and none exceeding 1.0 Δ dv were predicted using IMPROVE (2003) background data.

Table A2-1. IMPROVE Background Model Results.

Special Concern Area	Maximum Visibility Impact, IMPROVE Background Data (Δ dv)	Visibility Significance Criteria (Δ dv)	Number of Days Greater than or equal to 0.5 Δ dv[a]	Number of Days Greater than or equal to 1.0 Δ dv
Bridger Wilderness	0.52	0.5 / 1.0	1	0
Fitzpatrick Wilderness	0.41	0.5 / 1.0	0	0
Popo Agie Wilderness	0.52	0.5 / 1.0	1	0
Savage Run Wilderness	0.45	0.5 / 1.0	0	0
Wind River Roadless	0.47	0.5 / 1.0	0	0

[a] Note: The two occurrences greater than 0.5 Δ dv represent IMPROVE (2003) background data results.

APPENDIX B

Project-Wide Mitigation Measures and Procedures

2.2.11.1 Project-Wide Mitigation Measures and Procedures

Warren proposes to implement the following mitigation measures, procedures, and management requirements on public lands administered by the BLM to avoid land use impacts. On privately owned lands, the landowner would determine which measures would be applied, to what degree, and where. Warren would coordinate with the State of Wyoming concerning 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.

2.2.11.1.1 Preconstruction Planning and Design Measures

- Warren and the BLM would make on-site interdisciplinary team inspections of each proposed and staked facility site (e.g., well sites), new access road, access road reconstruction area, 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 PRPA would be accomplished in accordance with WSO BLM Manual 9113 Supplement, unless private landowners or the State of Wyoming specify otherwise.

- Warren 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. Prior to construction, Warren or its contractors would also 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.

- Construction activities would be slope–staked when required by the BLM for steep and/or unstable slopes and BLM approval would be received prior to start of construction.

2.2.11.2 Resource-Specific Requirements

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

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

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

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

- The best known weed prevention measures, as outlined in Appendix 4 of Partners *Against Weeds: An Action Plan for the Bureau of Land Management*, would be incorporated in the mitigation requirements.

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

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

- Muddy off-road equipment would be cleaned before moving into relatively weed-free areas.

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

- Disturbed areas would be stabilized and vegetation reestablished on all bare ground using mixtures and treatment guidelines prescribed in the approved APD/ROW as soon as practical to minimize weed spread.

- Gravel, top soil and fill would be stored in relatively weed-free areas.

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

- Disturbed and re-vegetated sites would be monitored to ensure that desired species are thriving and invasive/noxious weeds are not present, and treated, reseeded and fertilized as necessary.

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

- Warren would 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.

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

- Before treatment of invasive/noxious weeds, Warren would submit a Pesticide Use Proposal (PUP) to the BLM for approval, and 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) must be approved prior to any spraying. PUP's can be approved for up to a three year period.

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

- Pesticide Application Records would be submitted to the BLM RSFO each year. Treatments would 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.*

2.2.11.2.2 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. Warren 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).

- Warren 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.

- On Federal land, Warren 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).

- Warren would obtain the 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 WDEQ-AQD.

2.2.11.2.3 Transportation

- Existing and local roads would be used as collectors whenever possible. Standards for road design would be consistent with WSO BLM Manual 9113 Supplement. Newly constructed *Resource Roads*, spur roads that provide point access and connect to local or collector roads, would be crowned and ditched with a 14-foot wide travelway and a design speed of 30 mph.

- On Federal land, Warren 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. 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).

- 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 would be avoided where possible in planning for new roads.

2.2.11.2.4 Minerals/Paleontology

Mitigation measures presented in the Soils and Water Resources sections would avoid or minimize many of the potential impacts to the surface and mineral resources. Protection of subsurface mineral resources from adverse impacts would be provided by the BLM casing and cementing policy contained in Onshore Order No. 2.

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 PRPA in areas where construction would disturb surface exposures or subsurface bedrock of the Green River, Wasatch, and Fort Union Formations. Field surveys would involve a visual examination of the formation by a BLM-approved paleontologist in areas of exposure, and would recommend additional mitigation, if necessary. 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 any 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, scientifically-significant invertebrate or plant fossil materials from federal land without a federal permit is illegal, and that 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 Authorized Officer (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, or monitoring, and may delay resumption of work.

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

2.2.11.2.5 Soils

Other mitigation measures listed herein would also apply to Soils. The primary mitigation activities concerning Soils are as follows:

- 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 in order to avoid creating separate areas of disturbance and reduce the total area of disturbance.
- Avoid using frozen or saturated soils as construction material.
- ”Limiting disturbance on slopes greater than 25%.” (USDI-BLM, 1997, p. 159)
- 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 would not encroach within 500 feet of perennial surface water and/or riparian areas 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.

2.2.11.2.6 Water Resources

Other mitigation measures listed in the Soils, and Vegetation and Wetlands sections would also apply to Water Resources. The primary mitigation activities concerning Water Resources are as follows:

- 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.

- Surface disturbing activities would avoid the area within 500 feet of or on 100-year floodplains, wetlands, riparian areas, or perennial streams and within 100 feet of the edge of the inner gorge of intermittent and large ephemeral drainages. Proposals for linear crossings in these areas would be considered on a case-by-case basis.

- 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 replace the same or very similar bed material.

- 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 total dissolved solids 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 determine whether reinforcement and/or lining are required. If lining is required, as specified in the GRRMP (50 feet or less to ground water and permeability greater than 10^{-7} cm/hour), line the reserve pit with a reinforced synthetic liner at least 12 mils in thickness with a bursting strength of 175 x 175 pounds per inch. 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, the 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 into undisturbed vegetation.

- Develop and implement a pollution prevention plan for storm water runoff at drill sites, as required per WDEQ-WQD storm water National Pollution Discharge Elimination

System permit requirements. The WDEQ-WQD 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 112), a Spill Prevention Control and Countermeasures plan would be developed in accordance with 40 CFR 112, dated December 1973.

- Coordinate all crossings or encroachments of waters of the U.S. with the 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.

2.2.11.2.7 Fisheries

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

2.2.11.2.8 Vegetation and Wetlands

Other mitigation measures under Soils and Water Resources would also apply to Vegetation and Wetlands. The primary mitigation activities concerning Vegetation and Wetlands are as follows:

- 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 outside 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.

2.2.11.2.9 Wildlife

The primary mitigation activities concerning Wildlife are as follows:

- 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 according to BLM authorizations within big game crucial winter range from November 15 to April 30.

- Complete a raptor survey of the PRPA 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 GRRMP 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.

2.2.11.2.10 Special Status Species

The primary mitigation activities concerning Special Status Species are as follows:

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.

- 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.

2.2.11.2.11 Visual Resources

The primary mitigation activities concerning Visual Resources are as follows:

- 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.

2.2.11.2.12 Noise

Mitigation concerning Noise is as follows:

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

2.2.11.2.13 Recreation

Measures under Wildlife, Transportation, Soils, Health and Safety, and Water Resources could apply to Recreation. The primary mitigation activities concerning Recreation are as follows:

- 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.

2.2.11.2.14 Socioeconomics

The primary mitigation activities concerning Socioeconomics are as follows:

- 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.

- Warren 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.

2.2.11.2.15 Cultural Resources

The primary mitigation activities concerning Cultural Resources are as follows:

- Conduct a Class III inventory prior to any ground disturbing activities and identify sites considered eligible for or already on the National Register of Historic Places (NRHP).

- If a site is considered eligible for or is already on the 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 AO would be immediately notified. Work would not resume until a Notice to Proceed is issued by the BLM AO.

2.2.11.2.16 Health and Safety

Measures listed under Air Quality and Water Quality would also apply to Health and Safety. The primary mitigation activities concerning Health and Safety are as follows:

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

- 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.

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

- 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.

- During construction and upon commencement of production operations, Warren would have a chemical or hazardous substance inventory for all such items that may be at the site. Warren would institute a Hazard Communication Program for its employees and would require subcontractor programs in accordance with the Occupational Safety and Health Administration, 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 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.

- Chemical and hazardous materials would be inventoried and reported in accordance with the Superfund Amendments and Reauthorization Act Title III, 40 CFR 335, if quantities exceeding 10,000 pounds or the threshold planning quantity 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.

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

Appendix B-1. Wildlife species observed or that may potentially occur on or near the Pacific Rim Project Area.

		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
MAMMALS								
Badger	*Taxidea taxus*	y	y		y			
Bighorn sheep	*Ovis canadensis*	y						
Beaver	*Castor canadensis*	y	y					
Big-brown bat	*Eptesicus fuscus*		y					
Bison	*Bison bison*	y	y					
Black-footed ferret	*Mustela nigripes*		y	y				
Bobcat	*Felis rufus*	y	y					
Bushy-tailed wood rat	*Neotoma cinerea*		y					
Cliff chipmunk	*Tamias dorsalis*		y					
Coyote	*Canis latrans*	y	y		y			
Deer mouse	*Peromyscus maniculatus*		y		y			
Desert cottontail	*Sylvilagus audubonii*	y	y		y			
Dusky shrew	*Sorex monticolus*		y					
Dwarf shrew	*Sorex nanus*		y					
Eastern cottontail	*Sciurus carolinensis*	y						
Elk	*Cervus elaphus*	y	y		y			
Feral horse	*Equus caballus*				y			
Golden-mantled groundsquirrel	*Spermophilus lateralis*		y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Great Basin Pocket Mouse	*Perognathus parvus*		y					
Hoary bat	*Lasiurus cinereus*	y	y	y				
Least chipmunk	*Tamias minimus*		y					
Little brown myotis	*Myotis lucifugus*	y						
Long-eared myotis	*Myotis evotis*		y	y				
Long-legged Myotis	*Myotis volans*		y					
Long-tailed vole	*Microtus longicaudus*		y					
Long-tailed weasel	*Mustela frenata*		y					
Masked shrew	*Sorex cinereus*		y					
Meadow vole	*Microtus pennsylvanicus*		y					
Montane vole	*Microtus montanus*		y					
Moose	*Alces alces shirasi*	y						
Mountain (Nuttall's) cottontail	*Sylvilagus nuttallii*	y	y					
Mountain lion	*Felis concolor*	y	y					
Mule deer	*Odocoileus hemionus*	y	y		y			
Muskrat	*Ondatra zibethicus*		y					
Northern grasshopper mouse	*Onychomys leucogaster*		y					
Northern pocket gopher	*Thomomys talpoides*		y					
Olive-backed pocket mouse	*Perognathus fasciatus*		y					
Ord's kangaroo rat	*Dipodomys ordii*		y		y			
Pinyon Mouse	*Peromyscus truei*		y					
Pronghorn antelope	*Antilocapra americana*	y	y		y			

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Pygmy Rabbit	*Sylviagus idahoensis*		y					
Raccoon	*Procyon lotor*	y						
Red fox	*Vulpes vulpes*	y	y		y			
Sagebrush vole	*Lemmiscus curtatus*		y					
Short-tailed (ermine) weasel	*Mustela erminea*	y	y					
Silky pocket mouse	*Perognathus flavus*		y					
Striped skunk	*Mephitis mephitis*	y	y					
Thirteen-lined groundsquirrel	*Spermophilus tridecemlineatus*	y	y					
Uinta Chipmunk	*Eutamias umbrinus*	y	y					
Uinta ground squirrel	*Spermophilus armatus*	y	y					
Vagrant Shrew	*Sorex vagrans*		y					
Western small-footed myotis	*Myotis ciliolabrum*		y					
White-tailed deer	*Odocoileus virginianus*	y						
White-tailed jackrabbit	*Lepus townsendii*	y	y		y			
White-tailed prairie dog	*Cynomys leucurus*	y	y	y	y			
Wyoming ground squirrel	*Spermophilus elegans*		y					
Wyoming pocket gopher	*Thomomys clusius*		y	y				
Yellow-bellied marmot	*Marmota flaviventris*		y					
Yellow-pine Chipmunk	*Eutamias amoenus*		y					
BIRDS								
Acorn Woodpecker	*Melanerpes formicivorus*		y					
American avocet	*Recurvirostra americana*	y	y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
American bittern	*Botaurus lentiginosus*		y					
American coot	*Fulica americana*		y					
American crow	*Corvus brachyrhynchos*	y	y		y			
American goldfinch	*Carduelis tristis*		y					
American kestrel	*Falco sparverius*	y	y					
American pipit	*Anthus rubescens*		y					
American redstart	*Setophaga ruticilla*		y					
American robin	*Turdus migratorius*		y					
American tree sparrow	*Spizella arborea*		y					
American white pelican	*Pelecanus erythrorhynchos*		y					
American wigeon	*Anas Americana*		y					
Ash-throated flycatcher	*Myiarchus cinerascens*		y					
Baird's sandpiper	*Calidris bairdii*		y					
Bald eagle	*Haliaeetus luecocephalus*	y	y					
Bank swallow	*Riparia riparia*	y	y					
Barn Owl	*Tyto alba*		y					
Barn swallow	*Hirundo rustica*		y					
Barrow's goldeneye	*Bucephala islandica*		y					
Belted kingfisher	*Ceryle alcyon*		y					
Black rosy-finch	*Leucosticte atrata*		y					
Black tern	*Chlidonias niger*		y					
Black-bellied plover	*Pluvialis dominicus*		y					
Black-billed magpie	*Pica pica*	y	y		y			

Appendix B-1. Continued.

		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Black-crowned night heron	*Nycticorax nycticorax*		y					
Black-necked stilt	*Himantopus mexicanus*		y					
Black-throated gray warbler	*Dendroica caerulescens*		y					
Black-throated Sparrow	*Amphispiza bilineata*		y					
Blue grosbeak	*Guiraca caerulea*		y					
Blue grouse	*Dendragapus obscurus*		y					
Blue-gray gnatcatcher	*Polioptila caerulea*		y					
Blue-winged teal	*Anas discors*	y	y					
Bobolink	*Dolichonyx oryzivorus*		y					
Bonaparte's gull	*Spizella breweri*		y					
Brewer's sparrow	*Euphagus cyanocephalus*	y	y	y				
Brewer's blackbird	*Selasphorus platycercus*	y	y					
Broad-tailed hummingbird	Selasphorus platycercus		y					
Broad-winged hawk	*Buteo platypterus*		y					
Brown thrasher	*Taxostoma rufum*		y					
Brown-capped rosy-finch	*Leucosticte australis*		y					
Brown-headed cowbird	*Molothrus ater*		y					
Bufflehead	*Bucephala albeola*		y					
Burrowing owl	*Athene cunicularia*	y	y	y	y			
Bushtit	*Psaltriparus minimus*		y					
California gull	*Larus californicus*	y	y					
Calliope hummingbird	*Stellula callipe*		y					
Canada goose	*Branta canadensis*		y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Canvasback	*Aythya valisineria*		y					
Canyon wren	*Catherpes mexicanus*		y					
Caspian Tern	*Sterna caspia*		y					
Cassin's finch	*Carpodacus cassinii*		y					
Cattle egret	*Bubulcus ibis*		y					
Cedar waxwing	*Bombycilla cedrorum*		y					
Chestnust-collared longspur	*Calcarius ornatus*		y					
Chipping sparrow	*Spizella passerina*		y					
Chukar	*Alectoris chukar*	y						
Cinnamon teal	*Anas cyanoptera*	y	y					
Clarks grebe	*Aechmophorus clarkii*		y					
Clark's nutcracker	*Nucifraga columbiana*		y					
Clay-colored sparrow	*Spizella pallifa*		y					
Cliff swallow	*Hirundo pyrrhonota*		y					
Common goldeneye	*Bucephala clangula*		y					
Common grackle	*Quiscalus quiscula*		y					
Common loon	*Gavia immer*		y					
Common merganser	*Mergus merganser*		y					
Common nighthawk	*Chordeiles minor*		y					
Common poorwill	*Phalaenoptilus nuttallii*		y					
Common raven	*Corvus corax*	y	y		y			
Common redpoll	*Carduelis flammea*		y					
Common snipe	*Gallinago gallinago*	y	y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Common tern	*Sterna hirundo*		y					
Common yellowthroat	*Geothylpis trichas*		y					
Cooper's hawk	*Accipiter cooperii*	y	y					
Cordilleran fly catcher	*Empidonax occidentalis*		y					
Dark-eyed junco	*Junco hyemalis*	y	y					
Double-crested cormorant	*Phalacrocorax auritus*		y					
Downy woodpecker	*Picoides pubescens*		y					
Dunlin	*Calidris alpina*		y					
Dusky flycatcher	*Empidonax oberholseri*		y					
Eared grebe	*Podiceps nigricollis*		y					
Eastern kingbird	*Tyrannus tyrannus*		y					
European starling	*Sturnus vulgaris*		y					
Evening grosbeak	*Coccothraustes vespertinus*		y					
Ferruginous hawk	*Buteo regalis*	y	y					
Forster's tern	*Sterna forsteri*		y					
Fox sparrow	*Passerella iliaca*		y					
Franklin's gull	*Larus pipixcan*		y					
Gadwall	*Anas strepera*		y					
Golden eagle	*Aquila chrysaetos*	y	y		y			
Golden-crowned kinglet	*Regulus satrapa*		y					
Gray catbird	*Dumetella carolinensis*		y					
Gray flycatcher	*Empidonax wrightii*		y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Gray jay	*Perisoreus canadensis*		y					
Gray partridge	*Perdix perdix*	y						
Gray-crowned rosy-finch	*Leucosticte tephrocotis*	y	y					
Great-blue heron	*Ardea herodias*	y	y					
Greater yellowlegs	*Tringa melanoleuca*		y					
Greater Scaup	*Aythya marila*		y					
Great horned owl	*Bubo virginianus*	y	y					
Green-tailed towhee	*Pipilo chlorurus*		y					
Green-winged teal	*Anas crecca*	y	y					
Hairy woodpecker	*Picoides villosus*		y					
Horned grebe	*Podiceps auritus*		y					
Hermit thrush	*Catharus guttatus*		y					
Herring gull	*Larus argentatus*		y					
Hooded merganser	*Lophodytes cucullatus*		y					
Horned lark	*Eremophila alpestris*	y	y		y			
House finch	*Carpodacus mexicanus*	y	y					
House sparrow	*Passer domesticus*		y					
House wren	*Troglodytes aedon*		y					
Killdeer	*Charadrius vociferus*	y	y					
Lark bunting	*Calamospiza melanocorys*		y					
Lark sparrow	*Chondestes grammacus*		y					
Lazuli bunting	*Passerina ameoena*		y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Least sandpiper	*Calidris minutilla*	y	y					
Lesser scaup	*Aythya affinis*		y					
Lesser yellowlegs	*Tringa flavipes*		y					
Lewis' woodpecker	*Melanerpes lewis*		y					
Lincoln's sparrow	*Melospiza lincolnii*		y					
Loggerhead shrike	*Lanius ludovicianus*	y	y		y			
Long-billed curlew	*Numenius americanus*	y	y					
Long-billed dowitcher	*Limnodromus scolopaceus*		y					
Long-eared owl	*Asio otus*		y					
Macgillivray's warbler	*Oporornis tolmiei*		y					
Mallard	*Anas platyrhynchos*	y	y					
Marbled godwit	*Limosa fedora*		y					
Marsh wren	*Cistothorus palustris*		y					
McCown's longspur	*Calcarius mccownii*		y					
Merlin	*Falco columbarius*		y					
Mountain bluebird	*Sialia currucoides*	y	y					
Mountain chickadee	*Parus gambeli*		y					
Mountain plover	*Charadrius montanus*		y					
Mourning dove	*Zenaida macroura*	y	y					
Nashville Warbler	*Vermivora ruficapilla*		y					
Northern (Bullock's) oriole	*Icterus bullockii*		y					
Northern flicker	*Colaptes auratus*	y	y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Northern goshawk	*Accipiter gentilis*		y					
Northern harrier	*Circus cyaneus*	y	y					
Northern mockingbird	*Mimus polyglottos*		y					
Northern pintail	*Anas acuta*	y	y					
Northern rough-winged swallow	*Stelgidopteryx serripennis*		y					
Northern saw-whet owl	Aegolius acadicus		y					
Northern shoveler	*Anas clypeata*		y					
Northern shrike	*Lanius excubitor*		y					
Oldsquaw	*Clangula hyemalis*		y					
Olive-sided flycatcher	*Contopus borealis*		y					
Orange-crowned warbler	*Vermivora celata*		y					
Pacific loon	*Gavia pacifica*		y					
Peregrine falcon	*Falco peregrinus*		y					
Pied billed grebe	*Podilymbus podiceps*		y					
Pine siskin	*Carduelis pinus*		y					
Pinyon jay	*Gymnorhinus cyanocephalus*	y	y					
Plumbeous vireo	*Vireo plumbeus*		y					
Prairie falcon	*Falco mexicanus*	y	y					
Red crossbill	*Loxia curvirostra*		y					
Red-breasted merganser	*Mergus serrator*		y					
Red-breasted nuthatch	*Sitta canadensis*	y	y					
Redhead	*Aythya americana*		y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Red-headed woodpecker	*Melanerpes erythrocephalus*		y					
Redknot	*Calidris canutus*		y					
Red-naped sapsucker	*Sphyrapicus nuchalis*		y					
Red-necked grebe	*Podiceps grisegena*		y					
Red-necked phalarope	*Phalaropus lobatus*	y	y					
Red phalarope	*Phalaropus fulicaria*		y					
Red-tailed hawk	*Buteo jamaicensis*	y	y		y			
Red-winged blackbird	*Agelaius phoeniceus*	y	y					
Ring-billed gull	*Larus delawarensis*		y					
Ring-necked duck	*Aythya collaris*		y					
Rock dove	*Columba livia*		y					
Rock wren	*Salpinctes obsoletus*	y	y					
Ross' Goose	*Chen rossii*		y					
Rough-legged hawk	*Buteo lagopus*	y	y					
Ruby-crowned kinglet	*Regulus calendula*		y					
Ruddy duck	*Oxyura jamaicensis*		y					
Rufous hummingbird	*Selasphorus rufus*		y					
Greater sage-grouse	*Centrocercus urophasianus*	y	y	y	y			
Sabine's gull	*Xema sabini*		y					
Sage sparrow	*Amphispiza belli*	y	y	y				
Sage thrasher	*Oreoscoptes montanus*	y	y					
Sanderling	*Calidris alba*		y					
Sandhill crane	*Grus canadensis*	y	y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Savannah sparrow	*Passerculus sandwichensis*	y	y					
Say's phoebe	*Sayornis saya*		y					
Scott's oriole	*Icterus parisorum*		y					
Semipalmated plover	*Charadrius semiplamatus*		y					
Semipalmated sandpiper	*Calidris pusilla*		y					
Sharp-shinned hawk	*Accipiter striatus*		y					
Short-billed dowitcher	*Limnodromus griseus*		y					
Short-eared owl	*Asio flammeus*	y	y	y	y			
Snow bunting	*Plectrophenax nivalis*		y					
Snow goose	*Chen caerulescens*		y					
Snowy egret	*Egretta thula*		y					
Snowy owl	*Nyctea scandiaca*		y					
Snowy plover	*Charadrius alexandrinus*		y					
Sora	*Porzana carolina*		y					
Solitary sandpiper	*Tringa solitaria*		y					
Song sparrow	*Melospiza melodia*	y	y					
Spotted sandpiper	*Actitis macularia*		y					
Steller's jay	*Cyanocitta stelleri*		y					
Stilt sandpiper	*Calidris himantopus*		y					
Surf scoter	*Melanitta perspicillata*		y					
Swainson's hawk	*Buteo swainsoni*	y	y					
Swainson's thrush	*Catharus ustulatus*		y					
Three-toed woodpecker	*Picoides tridactylus*		y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
Townsend's solitaire	*Myadestes townsendii*		y					
Townsend's warbler	*Dendroica townsendii*		y					
Tree swallow	*Tachycineta bicolor*		y					
Trumpeter swan	*Cygnus buccinator*		y					
Tundra swan	*Cygnus columbianus*		y					
Turkey vulture	*Cathartes aura*	y	y					
Veery	*Catharus fuscescens*		y					
Vesper sparrow	*Pooecetes gramineus*		y					
Violet-green swallow	*Tachycineta thalassina*	y	y					
Virginia rail	*Rallus limicola*		y					
Virginia's warbler	*Vermivora virginiae*		y					
Warbling vireo	*Vireo gilvus*		y					
Western bluebird	*Sialia mexicana*		y					
Western grebe	*Aechmophorus occidentalis*		y					
Western kingbird	*Tyrannus verticalis*		y					
Western meadowlark	*Sturnella neglecta*	y	y					
Western sandpiper	*Calidris mauri*		y					
Western scrub-jay	*Apheloma californica*		y					
Western tanager	*Piranga ludoviciana*		y					
Western wood-peewee	*Cantopus sordidulus*		y					
Whimbrel	*Numenius phaeopus*		y					
White-breasted nuthatch	*Sitta carolinensis*		y					
White-crowned sparrow	*Zonotrichia leucoophrys*		y					
White-faced ibis	*Plegadis chihi*	y	y					

Appendix B-1. Continued.								
		Data Sources*						
Common Name	**Scientific Name**	**WOS**	**ATLAS**	**WYNDD**	**HWA**			
White-throated swift	*Aeronautes saxatalis*	y	y					
White-winged crossbill	*Loxia leucoptera*		y					
White-winged scoter	*Melanitta fusca*		y					
Willet	*Catotrophorus semipalmatus*		y					
Williamson's sapsucker	*Sphyrapicus thyroideus*		y					
Willow flycatcher	*Empidonax traillii*		y					
Wilson's phalarope	*Phalaropus tricolor*	y	y					
Wilson's warbler	*Wilsonia pusilla*		y					
Wood duck	*Aix sponsa*		y					
Yellow warbler	*Dendroica petechia*		y					
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*		y					
Yellow-rumped warbler	*Dendroica coronata*		y					
AMPHIBIANS								
Boreal chorus frog	*Pseudacris triseriata maculata*		y					
Boreal toad	*Bufo boreas boreas*		y					
Great Basin spadefoot toad	*Scaphiopus intermontanus*		y	y				
Tiger salamander	*Ambystoma tigrinum*		y					
REPTILES								
Eastern short horned lizard	*Phrynosoma douglassi brevirostre*		y		y			
Great Basin gopher snake	*Pituophis melanoleucas deserticola*		y					
Northern sagebrush lizard	*Sceloporus graciosus graciosus*		y					
Prairie rattlesnake	*Crotalus vinidus vinidus*	y	y					
Wandering garter snake	*Thamnophis elegans vagrans*		y					

***Data Sources**							
- WGFD Wildlife Observation System (WGFD 2003a)							
- Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming (WGFD 1999)							
- Wyoming Natural Diversity Database (2003)							
- Hayden-Wing Associates Field Surveys 2003							

Appendix B-2. Fish species that may potentially occur in streams downstream of the Pacific Rim Project Area

Common Name	Scientific Name	Game or Non Game	Native Species	Salt Wells Creek	North Fork Vermillion Cr.	Bitter Creek	Green River	FOW	WSAM
Bluehead sucker	*Catostomus discobolus*	Non Game	Yes				Yes	x	x
Bonneville cutthroat trout	*Oncorhynchus clarki utah*	Game	No				Yes	x	
Bonytail	*Gila elegans*	Non Game	Yes				Yes		
Brown trout	*Salmo trutta*	Game	No			Yes	Yes	x	
Channel catfish	*Ictalurus punctatus*	Game	No				Yes	x	
Colorado pikeminnow	*Ptychocheilus lucius*	Non Game	Yes				Yes	x	
Common carp	*Cyprinus carpio*	Game	No				Yes	x	
Fathead minnow	*Pimephales promelas*	Non Game	No	Yes			Yes	x	x
Flannelmouth sucker	*Catostomus latipinnis*	Non Game	Yes			Yes	Yes	x	x
Humpback chub	*Gila cypha*	Non Game	Yes				Yes		
Kokanee	*Oncorhynchus nerka*	Game	No				Yes	x	
Lake chub	*Couesius plumbeus*	Non Game	No				Yes	x	x
Lake trout	*Salvelinus namaycush*	Game	No				Yes	x	
Longnose dace	*Rhinichthys cataractae*	Non Game	No				Yes	x	x
Mottled sculpin	*Cottus bairdi*	Non Game	Yes				Yes	x	x
Mountain sucker	*Catostomus platyrhynchus*	Non Game	Yes	Yes	Yes	Yes	Yes	x	x
Mountain whitefish	*Prosopium williamsoni*	Game	Yes				Yes	x	x
Rainbow trout	*Oncorhynchus mykiss*	Game	No				Yes	x	x
Razorback sucker	*Xyrauchen texanus*	Non Game	Yes				Yes		
Redside shiner	*Richardsonius balteatus*	Non Game	No			Yes	Yes	x	x
Roundtail chub	*Gila robusta*	Non Game	Yes				Yes	x	x
Smallmouth bass	*Micropterus dolomieu*	Game	No				Yes	x	
Snake River cutthroat trout	*Oncorhynchus clarki ssp.*	Game	No				Yes	x	
Speckled dace	*Rhinichthys osculus*	Non Game	Yes	Yes	Yes	Yes	Yes	x	x
Utah Chub	*Gila atraria*	Non Game	No			Yes	Yes		x
White sucker	*Catostomus commersoni*	Non Game	No	Yes		Yes	Yes	x	x

1 Data Sources:

- Fishes of Wyoming (FOW) (Baxter and Stone 1995)
- Warmwater Stream Assessment Manual (WSAM)(WGFD 2004)

APPENDIX C

ADDITIONAL
BLM-REQUIRED MITIGATION

The following additional mitigation measures were identified during the analysis (Chapter 4.0 of the EA) and will be applied by the BLM during the permitting process for individual components as deemed necessary to further reduce adverse impacts upon the environment. Furthermore, additional site-specific mitigation measures may be identified and applied during APD and ROW application reviews.

Implementation of these measures on state or private lands will be subject to state or landowner preferences and agreements with the operator. Lease stipulation will be enforced where applicable. Development activities on all lands will be conducted in accordance with all appropriate federal, state, and county, laws, rules and regulations.

Only those resource values where additional mitigations was identified during analysis are included.

4.1.3 Paleontology

- If necessary collection, identification, and curation of the fossil remains and potentially monitoring of on-going surface disturbance in the area of discovery will be performed.

- If fossil resources are uncovered as a result of survey of lands slated for disturbance associated with the Proposed Action or No Action Alternative, the project proponent and authorized personnel should immediately notify the BLM for consideration for further action.

- If such fossil resources are discovered during surface disturbance, work should cease immediately in the area of the discovery until the fossil remains can be evaluated for scientific significance by a BLM-permitted paleontologist.

- If fossil remains of significance are identified either during survey or during excavation then additional mitigation may be proposed as necessary.

4.2 Air Quality

- Warren will 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).

- If air quality analysis indicates exceedances in NO_x, the following types of control measures could be implemented; the reduction of compression requirements, electric compression or the use of nonselective catalytic reduction (NCR), lean combustion, or selective catalytic reduction (SCR) control technologies.

NO_x Mitigation

- 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

- 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.

- Warren should establish and enforce speed limits on all project related unpaved roads to reduce vehicle fugitive dust.

4.3 Soils

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

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

- 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 crossings 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.

- Include adequate drainage control devices and measures in thee road design (e.g., road berms and drainage ditches, diversion ditches, cross drains, culverts, out-sloping, and energy dissipaters) 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, matter, mulches, and vegetative covers. Implement a revegetation program as soon as possible to re-establish the soil protection afforded by a vegetal cover.

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

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

- 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.

4.4 Water Resource

- The BLM may deny the proposed surface disturbance within 500 feet of perennial surface water and/or wetland areas and/or within 100 feet of intermittent and ephemeral drainage channels.

- The BLM may deny activities in areas with high erosion potential and/or rugged topography.

- 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.

- Should any existing permitted groundwater rights (water wells) be adversely affected by the Proposed Action, Warren should rework, replace, or otherwise compensate the owner/permittee.

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

- Discharge all concentrated water flow within access road ROWs onto or through an energy dissipater structure (e.g. riprapped aprons and discharge point) 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 Systems (NPDES) permit requirements. The WDEQ requires operators to obtain a field permit for fields of 20 wells or more.

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

- 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 water 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 will 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 asses soil stability and permeability and whether reinforcement and/or lining are required. If lining is required, as specified in the GRRMP Decision Record as approved 1997 (50 feet or less to ground water and permeability greater than 10^{-7} cm/hour), line the reserve pit with a reinforce 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 or overflowing. Shut down drilling operations until the problem is corrected if leakage is found outside the pit.

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

- 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 dissipater. The water is to be discharged onto undisturbed land that has vegetative cover, if possible, or into an established drainage channel. Prior to discharge, threat or filiter 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 will not exceed the capacity of the channel to safely convey the increased flow. And the hydrostatic test water quality will be equal to or better than the receiving waters. Coordinate all discharge of test water with the Wyoming State Engineer's Office (WSEO), Wyoming Department of Environmental Quality/Water Quality Division (WDEQ/WQD), and the BLM.

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

- Shall existing water wells be adversely affected by the project, the company shall rework, replaced, or otherwise compensate the well owner.

4.6 Rangeland Resources

- The BLM will recommend that the Warren establish speed limits in the PRPA.

- Warren should coordinate with the affected livestock operators to minimize disruption during livestock operations, including calving season.

4.7 Wildlife

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

- 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.

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

- If "active" raptors nest are identified from survey, clear well sites within one mile of raptor nest identified prior to the commencement of drilling and construction during the raptor nesting period (February 1 through July 31).

- No permanent above ground structures will be constructed within 825 feet of an active raptor nest (NSO).

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

4.8 Special Status Wildlife, Fish and Plant Species

- The BLM may deny all project development actions within area where threatened, endangered, proposed, candidate, and other sensitive plant and animal species are found or are likely to occur.

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

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

- BLM may require that noise level increases be limited to no more than 10dBA above background levels at Greater sage-grouse leks. To provide additional protection for sage-grouse and other area wildlife, the BLM may require powerlines to be buried.

- Do not perform construction activities within 0.25 miles of existing sage-grouse leks at any time except as authorized in writing by exception, including documented supporting analysis by the Authorizing Officer. All surface

disturbances will abide by sage-grouse stipulations as detailed in the GRRMP Decision Record as approved 1997.

- 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 leks. Exception maybe granted if the activity will occur in unsuitable nesting habitat.

- Monitor and control noxious weeds.

- Warren and operators are to comply with Section 404(b)(1) guidelines of the federal Clear Water Act (CWA).

4.10 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 that blends with the adjacent surrounding undisturbed terrain, except from structures that require safety coloration in accordance with Occupational Safety and Health Administration (OSHA) requirements.

4.11 Cultural Resources

- Impacts to cultural resources would be mitigated following procedures as specified in 36 CFR 800 and/or the national programmatic agreement for cultural resources and statewide protocol.

- Mitigation procedures will be implemented if a site considered eligible (under "Criterion d" only) or listed on the National Register is impacted.

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

- All resources identified during these inventories would be evaluated for eligibility for the National Register of Historic Places (NRHP) by BLM, and the State Historic Preservation Office (SHPO) would be consulted as necessary under the statewide protocol.

- Avoidance is preferred and is achieved through redesign of a project, elimination of the project, or minimizing impacts. However, these means are not always possible.

- Mitigation of adverse effects to properties would be accomplished by the documentation of physical remains.

- Mitigation would include data recovery of prehistoric and historic sites and could include documentation through detailed drawings and photographs of standing structures.

- Data recovery plans are subject to review and approval by the BLM, SHPO, and the Advisory Council on Historic Preservation.

4.12 Socioeconomics

- Warren should ensure that its non-local contractors have secured adequate temporary housing for employees.

- Warren should ensure that all purchases of tangible goods are properly credited to Sweetwater County for sales and use tax purposes.

- Warren 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 offset 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.

4.13 Transportation

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

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

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

Mitigation for impacts on State highways would include:

- Warren is responsible in obtaining all required WYDOT permits and approvals for constructing or improving road access to WYO 430.

- Coordination with WYDOT and the Sweetwater Road and Bridge Department to ensure that all approaches to WYO 430 are adequate to handle tractor trailer combinations.

- Coordination with WYDOT and the Sweetwater Road and Bridge Department to ensure that all approaches to WYO 430 are paved or otherwise treated to allow trucks to shed mud gravel before entering the highway.

Mitigation for County Roads would include:

- Warren will obtain access permits and/or licenses from the Sweetwater County Engineer's Department for any crossings, access to or utilization through Sweetwater County road rights of way.

- Warren is encouraged to participation in the Wamsutter – Continental Divide Transportation Planning Committee, if appropriate.

- There will be an operator and contractor policies to reinforce speed limits and other traffic safety laws on county and operator-maintained roads within the PRPA.

- Warren will provide assistance to the Sweetwater Road and Bridge Department in obtaining gravel, water and dust suppressant for application on affected county roads.

4.14 Health and Safety

- Warren 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.

- If hazardous materials are present within fracturing fluids, the BLM may deny the discharge of these fluids to reserve pits.

- 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 will be developed in accordance with 40 CFR Part 112, dated December 1973.

4.15 Noise

- In addition to measures described in Section 2.2.11.2.12, measures to mitigate noise impacts would include the following:

- In any area of operations (drill site, compressor site, etc.) where noise levels may exceed federal OSHA safe limits, The Operators and contractors would provide and require the use of proper personnel protective equipment by employees.

- BLM may require that noise levels be limited to no more than 10dBA above background levels at Greater sage-grouse leks.

APPENDIX D

UNITED STATES FISH AND WILDLIFE SERVICE
FINAL CONFERENCE OPINION OR CONFORMATION LETTER
FOR THE
PACIFIC RIM SHALLOW GAS EXPLORATION
AND
DEVELOPMENT PROJECT
SWEETWATER COUNTY, WYOMING

3162/6840 (040)
Pacific Rim Shallow Gas Project

August 16, 2004

Ms. Kathleen Erwin
U.S. Fish and Wildlife Service
Ecological Services
4000 Airport Parkway
Cheyenne, Wyoming 82001

Dear Ms. Erwin:

We have received notification that Warren E. & P., is planning to expand their pilot shallow gas project with the addition of more wells. The U.S. Fish and Wildlife Service provided comments and a list of endangered, threatened, candidate, and proposed species to the scoping statement late last year.

This letter represents consultation in compliance with the Endangered Species Act of 1972 in which we request your concurrence on our determinations for the following species.

Bald Eagle

Nesting and roost habitat does *not* occur in the area of proposed activity. The nearest Bald eagle feeding and winter roosting habitat to this project is about 55 miles to the northwest, on the Green River.

Determination: There would be "no affect" to bald eagles or their habitat as a result of the project.

Minimization Measures: None needed.

Black Footed Ferret

White-tailed prairie dog colonies are known to occur within the project area. Ferret searches have been completed by the project proponent on colonies that may be impacted by surface disturbing activity. No evidence of ferrets has been identified. Ferret searches will continue for additional projects should they occur within active prairie dog colonies.

Determination: The implementation of the proposed action would result in a "may affect, not likely to adversely affect" determination for the black-footed ferret.
Minimization Measures: Continue to monitor prairie dog colonies within the Pacific Rim area and prescribe avoidance and/or require ferret searches.

Ute Ladies'-tresses
Ute Ladies'-tresses habitat is not present in the analysis area. The Pacific Rim shallow gas project area has no riparian habitat, nor perennial streams to provide habitat for this species.

> *Determination*: Continued drilling and development of the Pacific Rim project will result in a "no affect" determination for this species.
>
> *Minimization Measures*: None required.

Colorado River water depletions
With this letter we wish to initiate formal consultation for the Colorado River endangered fishes and their designated critical habitat. Water depletion from the Colorado River and its tributaries has been determined to be jeopardizing the continued existence of four endangered fish downstream from the project area.

Water use for the entire project is based on the amount of water it requires for drilling, pipeline hydrostatic testing and road dust abatement. The total amount will be within the range of 0.88 acre feet/year and 1.42 acre feet/year. Water for this project is presently being purchased from the Joint Powers and Water Board in Rock Springs (100% municipal water). Produced water within the project is being injected through Warren's injection well located in Section 31, T15N, R101W.

> *Determination*: "No affect" to the four Colorado River fishes and/or their designated critical habitat.
>
> *Minimization Measures*: None needed.

The following species were address in the original species list at the beginning of the project but no longer have status under the ESA, or are currently under review by the FWS. These species are discussed for the Fish and Wildlife Service's information and to show our ongoing support of the Endangered Species Act.

Yellow-billed cuckoo
The yellow-billed cuckoo is a candidate for listing as threatened under the Endangered Species Act (1972) and may occur in riparian areas west of the Continental Divide in Wyoming. The Pacific Rim area contains no habitat which would be suitable for this species.

> *Determination*: Continued gas exploration and development and pursuant activities would have no impacts to the yellow-billed cuckoo.
>
> *Minimization Measures*: None needed.

Mountain Plover
Considerable mountain plover habitat is present within the proposed shallow gas development area. This habitat is found in valley bottoms and within prairie dog colonies. Suitable mountain plover habitat will be avoided by surface disturbance activities during the period of April 10 through July 10 annually.

Greater Sage Grouse
Two sage grouse strutting grounds (leks) are known to occur within the proposed lease area. Although present attendance at these leks is low, nesting has been known to occur in suitable habitat. A "controlled surface use" stipulation will be applied from February 1 through May 15, within ¼ mile radius of active strutting grounds from 6 p.m. to 9 a.m. daily. The actual timing of this stipulation can be modified by weather conditions such as fog and cloudy conditions, or clear, bright moonlit nights. Seasonal restrictions would be applied through July 31, within an additional 1.75 mile radius from lek perimeters to protect sage grouse nesting habitat. Areas within that area not used for nesting can be excepted provided actual nesting areas are not affected.

Should you require additional information for please contact Lorraine Keith at Lorraine Keith_@BLM.GOV, or call 307-352-0308.

Sincerely

/s/ Michael R. Holbert

Michael R. Holbert
Field Manager

Attachments: Project area map for the Pacific Rim shallow gas project.

cc: file 3162/6840 (040)

Bcc Lorraine Keith
Darlene Horsey

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4000 Airport Parkway
Cheyenne, Wyoming 82001

In Reply Refer To:
ES-61411/W.02/WY8733

Memorandum

To: Michael Holbert, Field Manager, Bureau of Land Management, Rock Springs Field Office, Rock Springs, Wyoming

From: Brian T. Kelly, Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming

Subject: Request for Concurrence for the Pacific Rim Shallow Gas Project

Thank you for your letter of August 16, 2004, regarding the proposed Pacific Rim shallow gas project located in T13-15N, R100-101W in Sweetwater County, Wyoming. You have stated that the project proponent is proposing to expand the existing pilot project. Our office provided comments regarding 120 proposed wells in our scoping letter of November 6, 2003. You have requested concurrence for your determinations of effects to listed and proposed species pursuant to the Endangered Species Act of 1973 (Act), as amended, 16 U.S.C. 1531 *et seq*. Based on our review of your letter and subsequent information, the Service's concurrence is not required for this project. We are providing the following comments based on the information provided in your letter and August 24, 2004, email from Lorraine Keith, wildlife biologist with the Bureau of Land Management's (Bureau) Rock Springs Office.

Your letter indicates that white-tailed prairie dog towns and/or complexes occur within the project area. A personal communication with Lorraine Keith, of your office, stated that black-footed ferret surveys were conducted in mid-October of 2003 pursuant to the Black-footed Ferret Survey Guidelines (1989). Additionally, recent efforts by the Service, the Wyoming Game and Fish Department as well as others, has identified this area as being block cleared and surveys for ferrets are no longer warranted (letter of February 2, 2004). Based on this information the Service believes that the project area is not likely to be inhabited by black-footed ferrets, and consultation for this species is not required. We do, however, continue to recommend that prairie dog towns be protected for their value to the myriad of species that inhabit them and for potential future reintroduction of black-footed ferrets.

Your letter also indicates that depletions to the Colorado River system are expected from this project. However, the supplemental information provided in the August 8, 2004, email stated that your request for formal consultation for depletions was in error. The email clarified that all water used in dust abatement, drilling and hydrostatic testing of pipelines will be obtained from the Joint Powers and Water Board in Rock Springs for which a biological opinion was issued September 27, 1993. Therefore, consultation for Colorado River depletions is not required.

Your letter indicates that mountain plover (*Charadrius montanus*) and greater sage-grouse (*Centrocercus urophasianus*) habitat occurs within the project area. The Services commends your efforts to protect the mountain plover by prohibiting surface disturbing activities in plover habitat. Additionally, your letter discusses various measures to protect sage-grouse and their habitats. The Service recommends that protective measures follow those stated in Connelly (2000). The Service recommends that the Bureau use their authority to not grant exceptions to established protective measures.

We appreciate your efforts to ensure the conservation of endangered, threatened, and candidate species and migratory birds. If you have further questions regarding our comments or your responsibilities under the Act, please contact Kathleen Erwin of my staff at the letterhead address or phone (307)772-2374, extension 28.

References

Connelly J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28(4): 967 - 985.

USFWS. 1989. Black-footed ferret survey guidelines for compliance with the Endangered Species Act. U.S. Fish and Wildlife Service, Denver, Colorado and Albuquerque, New Mexico. 13pp.

cc: WGF, Lander, Non-Game Coordinator (B.Oakleaf)
WGF, Cheyenne, Statewide Habitat Protection Coordinator (V. Stelter)

BLACK-FOOTED FERRET SURVEY RESULTS

ON THE

PACIFIC RIM PROJECT AREA

SEPTEMBER, 2003

Prepared For:

U.S. Department of Interior
Bureau of Land Management
Rock Springs Field Office
Rock Springs, Wyoming

Prepared By:

Hayden-Wing Associates
Environmental Consultants
P.O. Box 1689
Laramie, WY 82073

October, 2003

Black-footed Ferret Survey Results

Warren Exploration & Production, Inc.

Introduction

The black-footed ferret is classified by the U.S. Fish and Wildlife Service (FWS) as Endangered and is listed under the Endangered Species Act of 1973, as amended in 1982, and is subject to federal regulations and guidelines to implement the species' recovery. Environmental disturbances in areas where ferrets potentially occur, demand that surveys be undertaken to determine whether or not they occur in the vicinity of the proposed action.

Warren Exploration & Production, Inc. has proposed the development of roads and coal bed natural gas wells that would impact white-tailed prairie dog habitats that occur in the following locations:

T15N:R102W - Sections	**T15N:R101W** - Sections
13, 24, 25, and 36	18, 19, 20, 21, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, and 35
T14N:R102W - Section	**T14N:R101W** - Sections
1, 11, 12, and 13	3, 5, 6, 7, 8, and 9

See Figures 1 and 8 of this report.

All prairie dog habitats are located in Sweetwater County, Wyoming. The Bureau of Land Management (BLM) and the U.S. Fish and Wildlife Service (FWS) require that entire prairie dog towns be surveyed and cleared for black-footed ferrets prior to construction. Such clearances of individual towns last for a period of 12 months.

Personnel involved in conducting the ferret surveys reported herein include: Mr. Jeff Winstead, Mr. Travis Olson, Mr. Kenneth Jones, Ms. Darla Knowlton, Mr. Larry Bennett, and Dr. Larry Hayden-Wing. Jeff Winstead, Travis Olson, and Kenneth Jones are certified by the FWS as biologists qualified to conduct ferret searches and were the leaders of the field teams that performed the surveys. Jeff Winstead and Larry Hayden-Wing compiled data and participated in the writing of this report. Dr. Hayden-Wing, also certified by the FWS as a biologist qualified to conduct ferret searches, supervised the overall project and report writing.

Methods

Aerial surveys of prairie dog colonies were conducted over the Pacific Rim Project Area on September 2, 2003. Linear transects were flown in a Cessna 180 aircraft with global positioning system (GPS) capabilities. Transects were flow at approximately 1/2-mile intervals at an average altitude of 200 feet. All towns were then mapped from the ground on ATV's. Where a burrow area is within 200 meters of another burrow area, these areas were lumped together to create a prairie dog town boundary used for surveying for black-footed ferrets. Twenty-two burrow areas within the above listed locations of proposed disturbance, were surveyed for black-footed ferrets. Town #1 is made up of 16 burrow areas, totaling 1,939.6 acres. Town # 2 consists of six separate towns (#s 20 through 25) that total 78.1 acres. The boundaries of these prairie dog towns were mapped using techniques outlined in Biggins et al. (1989).

Town #1 was divided into six survey areas that came as close to 320 acres in size as topography and discontinuities in town segments would allow. Survey areas on Town #1 varied in size from 319.15 to 329.88 acres, and averaged 323.26 acres. Pat Deibert, FWS biologist in the Cheyenne Office, allowed that the survey areas that exceeded the 320-acre maximum listed in the guidelines were acceptable, given that none of them exceed the guideline by more than 10 acres (Personal communication with Larry Hayden-Wing, October 1, 2003).

In accordance with the FWS Black-footed Ferret Survey Guidelines (FWS 1989), one 3-consecutive-night survey was conducted on each of the seven survey areas from approximately 2000 to 0600 hours for a total of 21 nights or 182.3 hours of survey time. Survey routes were established and marked with 4-foot high wooded stakes during daylight hours before the first of each 3-night survey and situated to allow spotlight illumination of each prairie dog town. Each route was traveled numerous times each night by two observers, with the direction of travel being reversed each survey run and a different starting point used at the beginning of every survey night. During the surveys, one observer operated a hand-held 700,000 candlepower spotlight and systematically illuminated areas on either side of the route, while the second biologist drove the vehicle at less than 5 miles per hour on the designated survey route and aided with observations. Locations of survey routes for the six survey areas of Town # 1 are illustrated on detailed maps (Figures 2 - 7), and in Figure 8 for Towns 20 - 25.

All wildlife observations made during each survey night were recorded on field forms (Appendix). Any indication of green eye-shine was investigated until the animal was identified. Binoculars were used to aid in distant observations. During the early morning, following the night-long surveys, different portions of the survey area were searched on foot to inspect burrow openings for signs of black-footed ferrets. Results of these daylight searches were recorded on field forms and are included in the Appendix. Survey summary forms, which include the total area and hours searched during the night-time and morning surveys are also included in the Appendix.

Results

No black-footed ferrets or their sign were observed during either the nocturnal spotlight surveys or the morning ground searches. Other species of wildlife observed during the surveys include cottontail rabbits, white-tailed jackrabbits, unknown mouse, unknown shrew, bushy-tailed wood rat, Ord's kangaroo rat, burrowing owl, flamulated owl, northern harrier, coyote, badger, short-tailed weasel, bobcat, wild horses, pronghorn, mule deer, and elk. Numbers and locations of species observed are listed on individual field forms in the Appendix.

Literature Cited

Biggins, D., B. Miller, B. Oakleaf, A. Farmer, R. Crete, and A. Dood. 1989. A system for evaluating black-footed ferret habitat. USFWS Rpt. 29pp.

US Fish and Wildlife Service (FWS). 1989. Black-footed ferret survey guidelines for compliance with the Endangered Species Act.. U.S. Fish and Wildlife Service, Denver, CO and Albuquerque, NM 14pp.

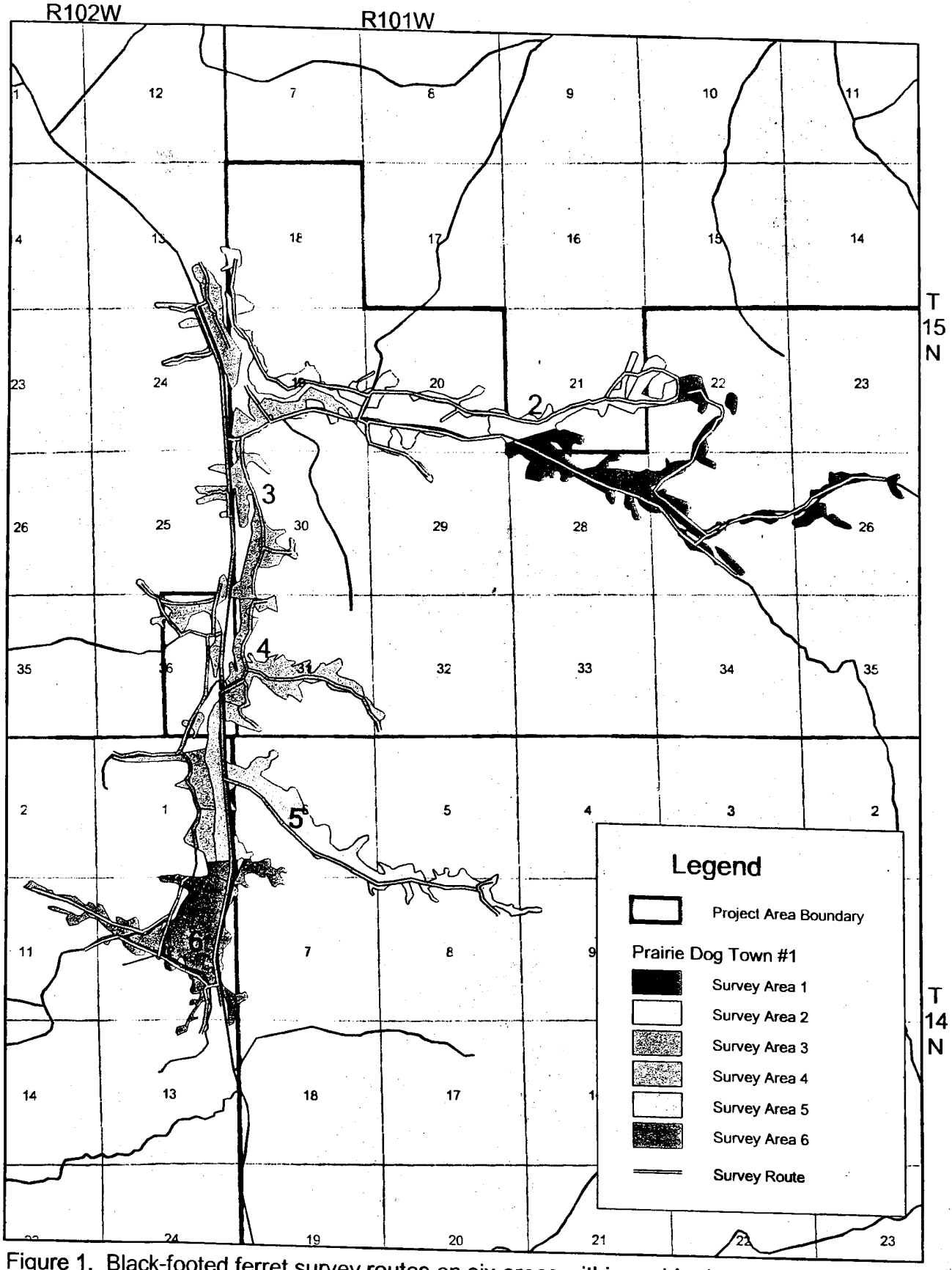

Figure 1. Black-footed ferret survey routes on six areas within prairie dog town #1 on the Pacific Rim Project Area.

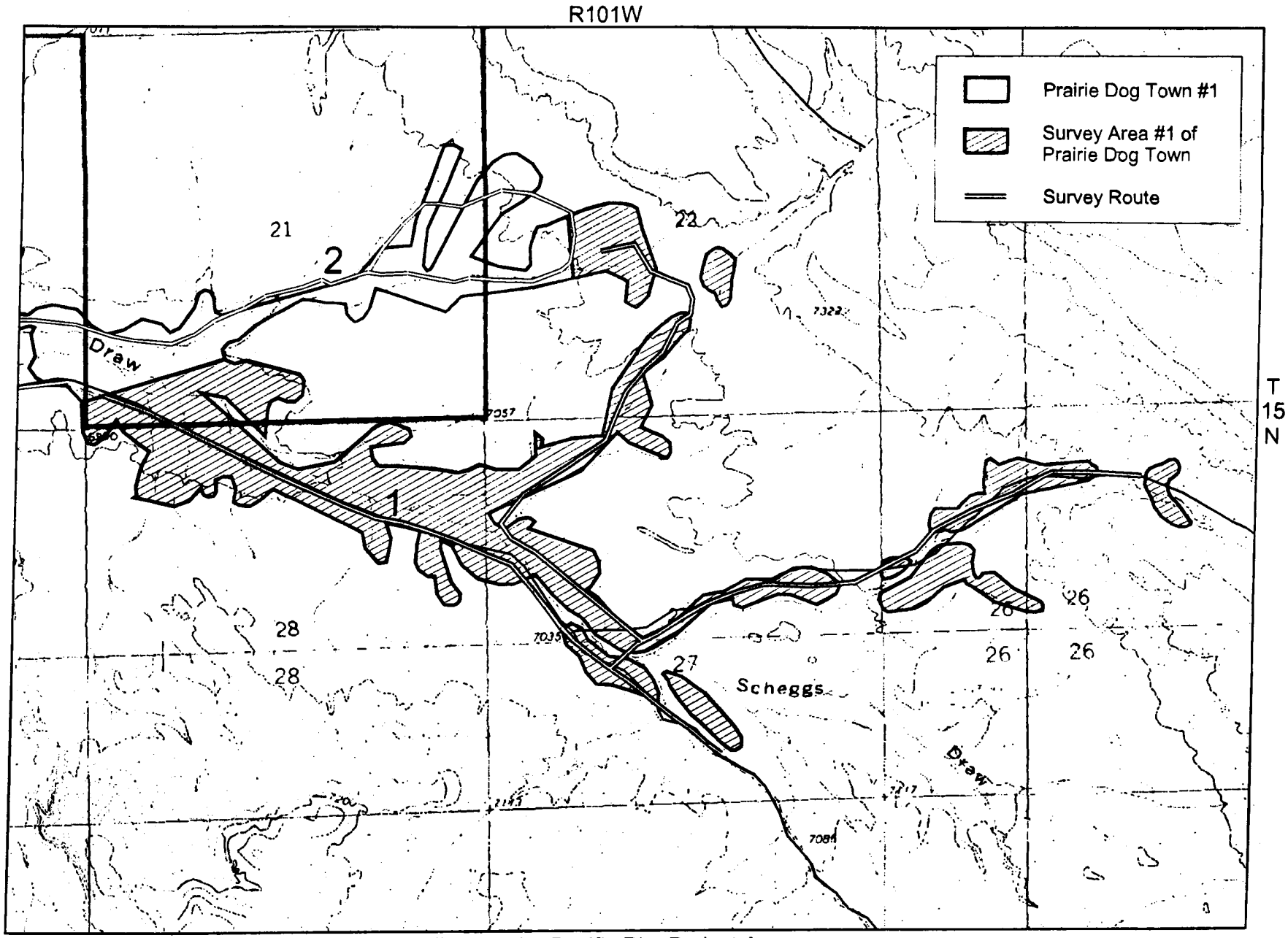

Figure 2. Black-footed ferret survey route #1-1 on the Pacific Rim Project Area.

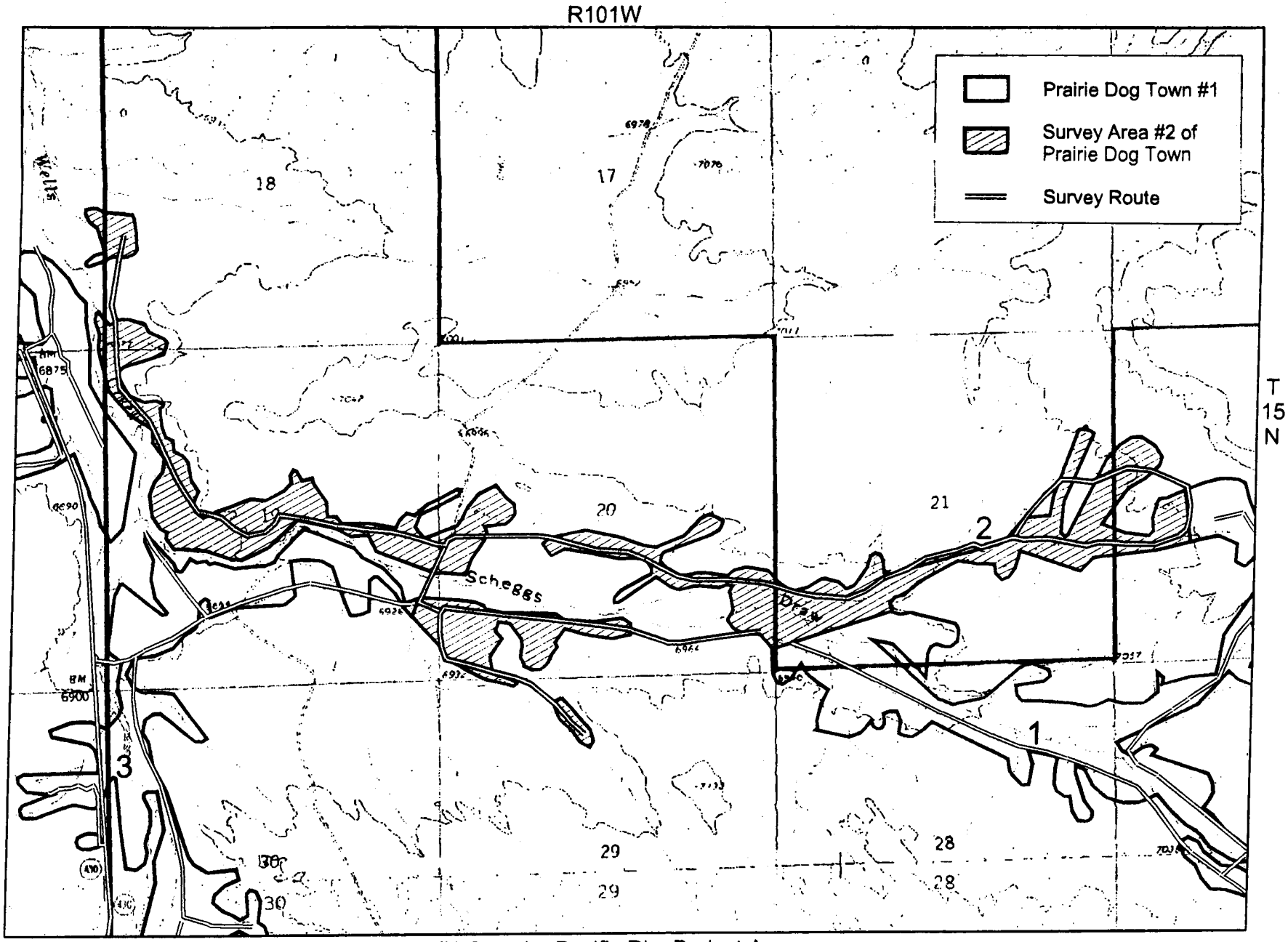

Figure 3 . Black-footed ferret survey route #1-2 on the Pacific Rim Project Area.

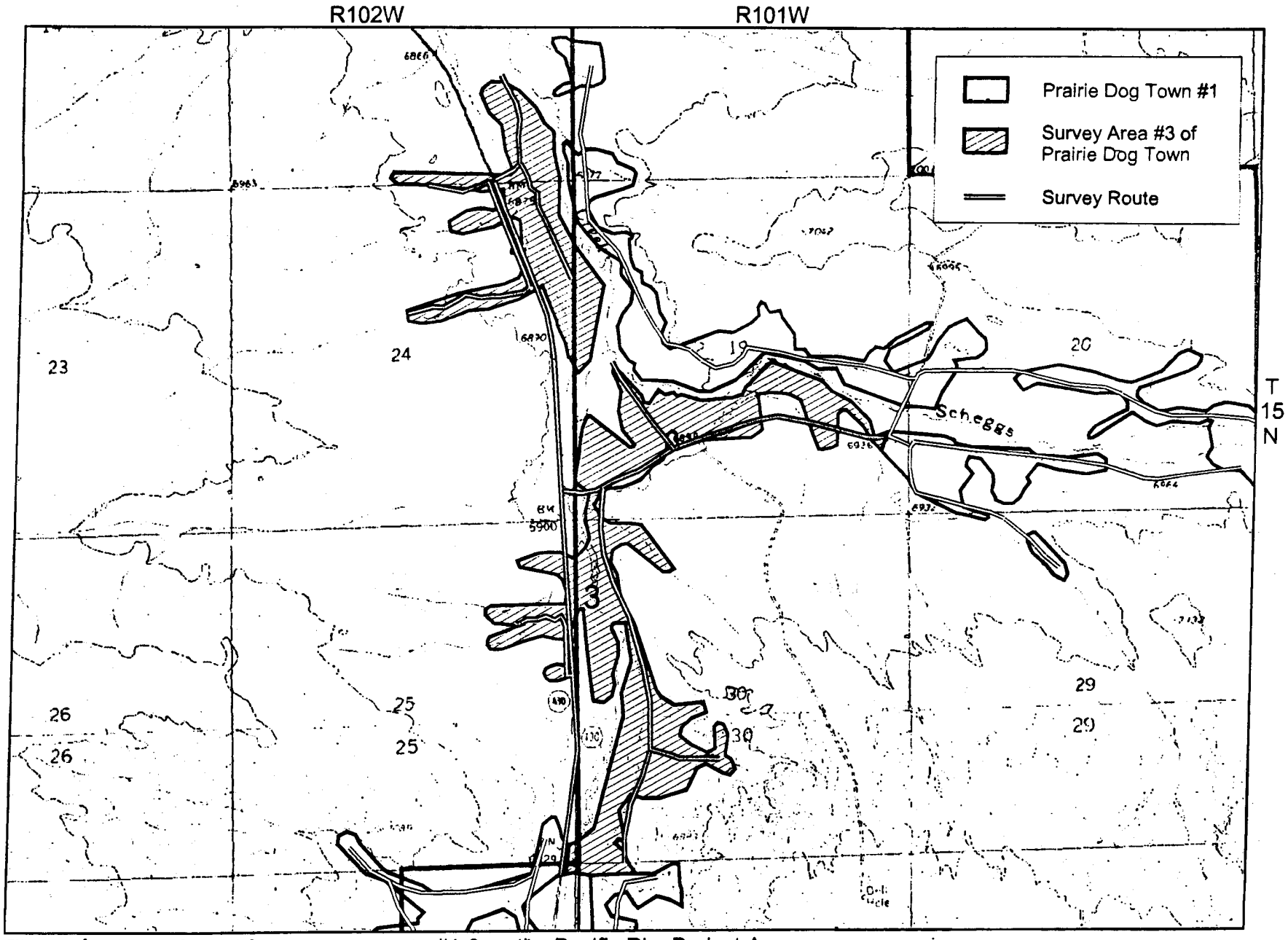

Figure 4 . Black-footed ferret survey route #1-3 on the Pacific Rim Project Area.

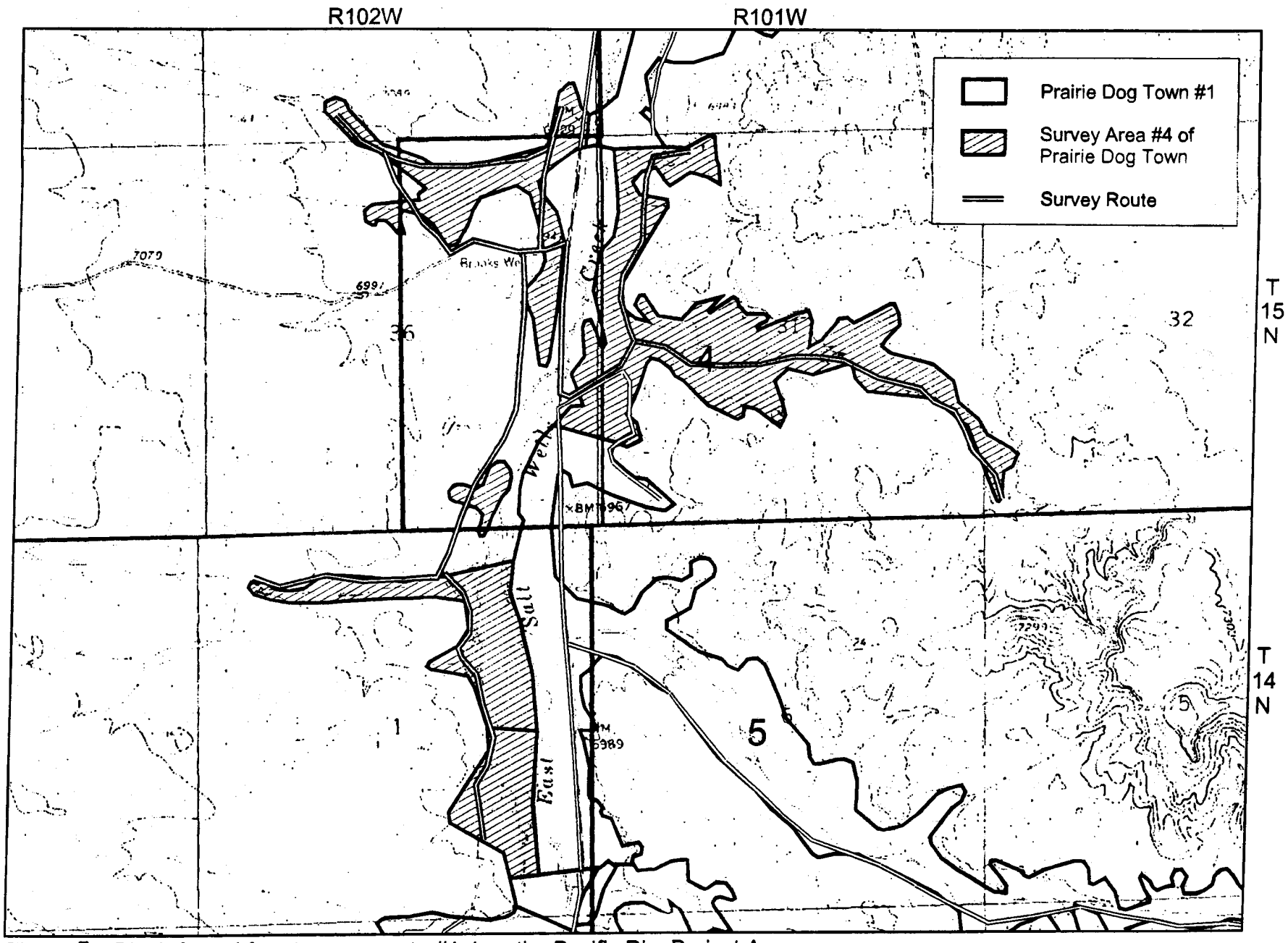

Figure 5 . Black-footed ferret survey route #1-4 on the Pacific Rim Project Area.

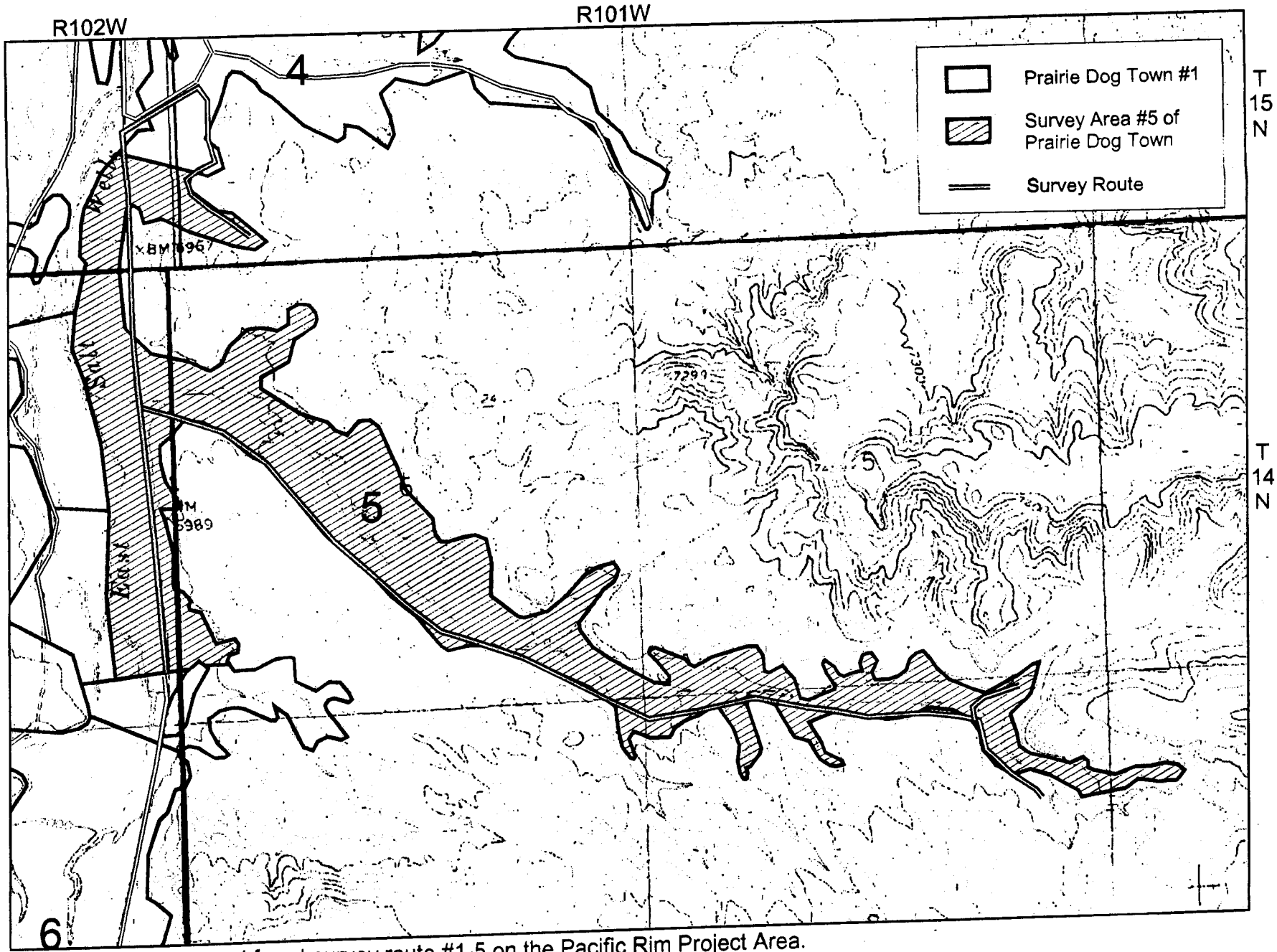

Figure 6 . Black-footed ferret survey route #1-5 on the Pacific Rim Project Area.

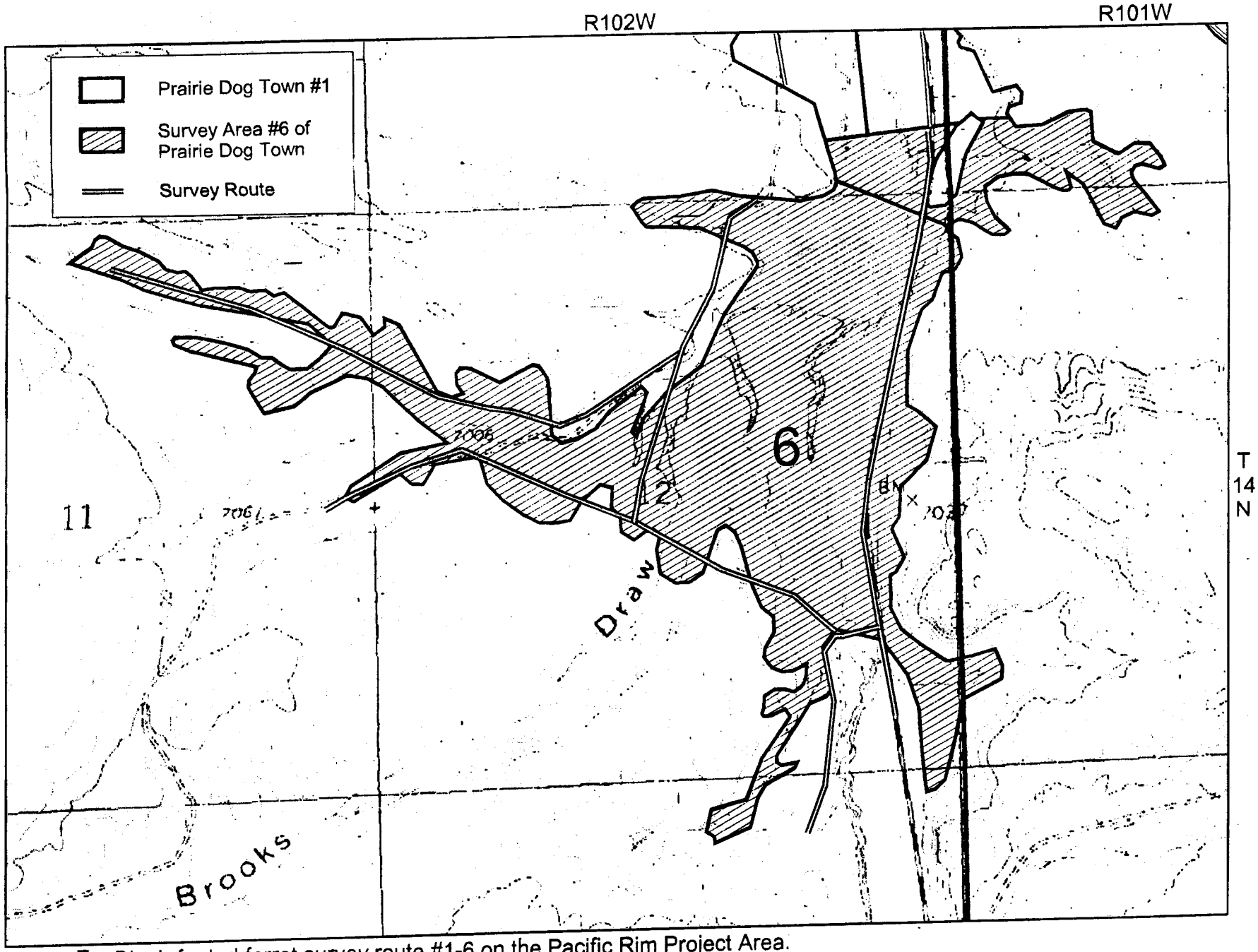

Figure 7 . Black-footed ferret survey route #1-6 on the Pacific Rim Project Area.

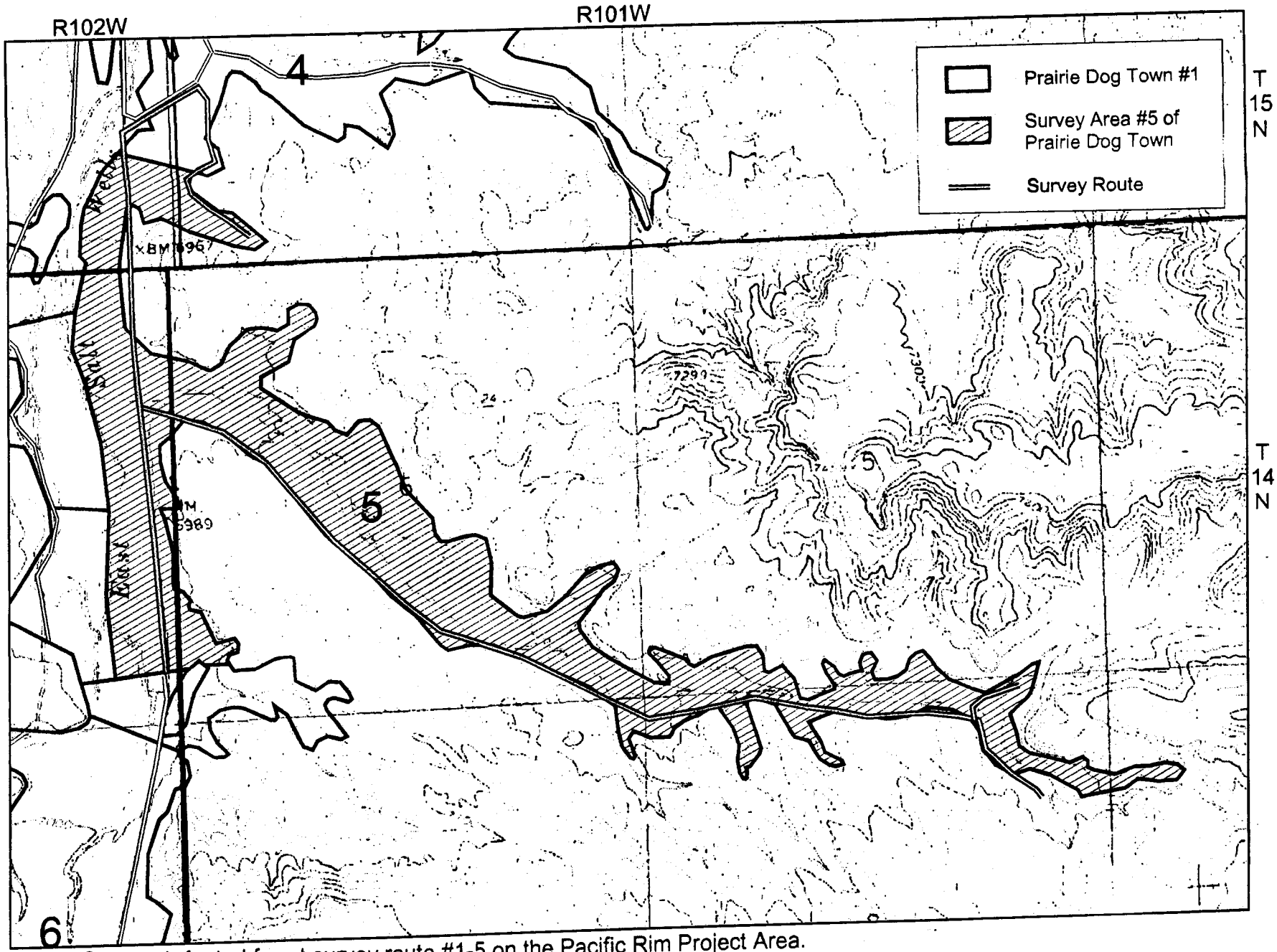

Figure 6 . Black-footed ferret survey route #1-5 on the Pacific Rim Project Area.

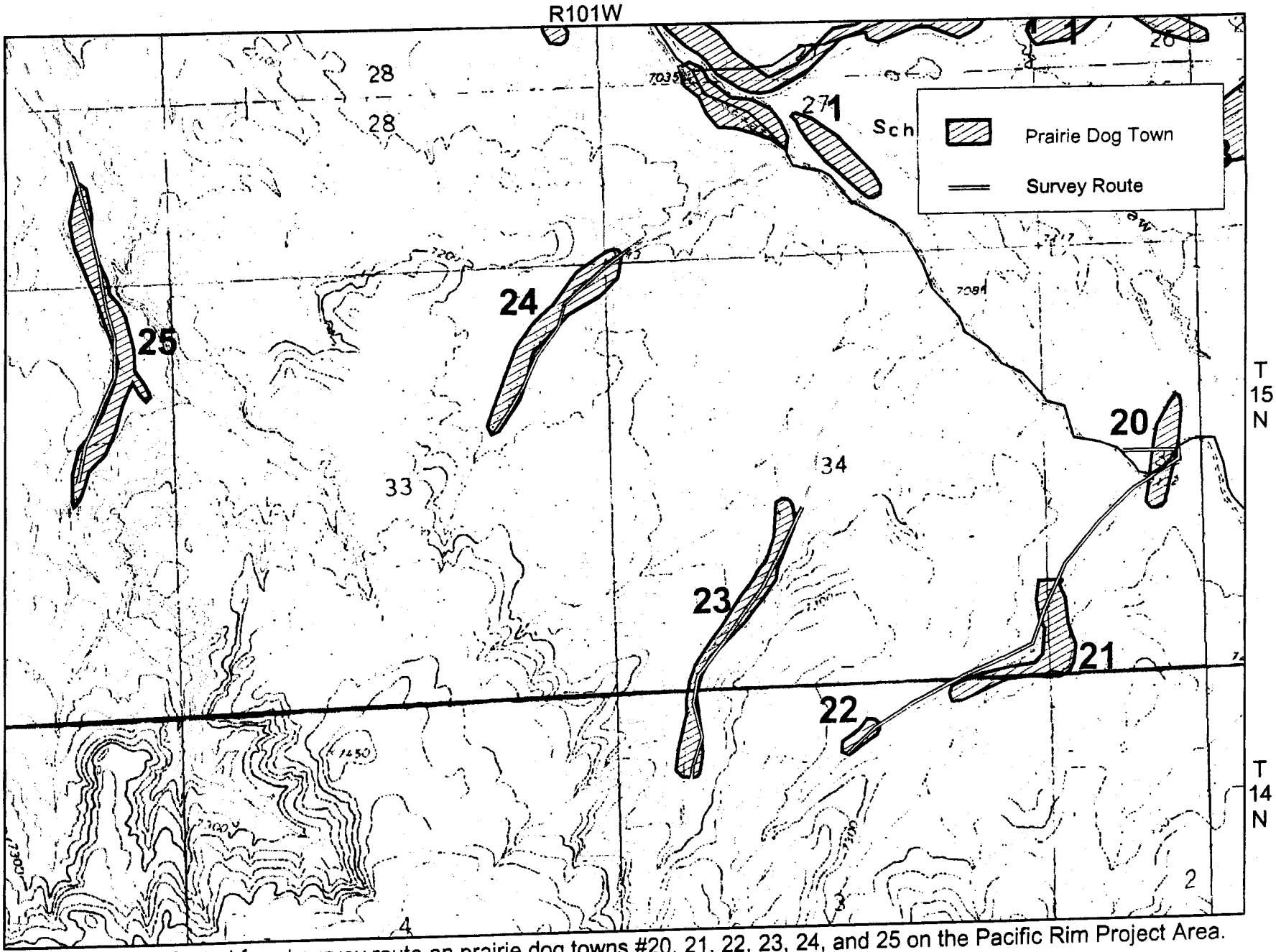

Figure 8. Black-footed ferret survey route on prairie dog towns #20, 21, 22, 23, 24, and 25 on the Pacific Rim Project Area.

APPENDIX F

STANDARD SEED MIXTURES
ROCK SPRINGS FIELD OFFICE

Appendix F

Standard Seed Mixtures

The following procedures will be followed by Warren E&P to assure that disturbed areas are stabilized and that revegetation efforts are enhanced.

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 in order 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, as well as 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, reduce evaporation from the soil surface, and protect 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 2-3 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 Wyoming Game and Fish Department (WGFD) recommends that BLM consider shrub, forb, and grass species in seed mixtures.

- BLM would coordinate with the WGFD to insure that the correct shrub, forb, and grass 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.

- Broadcast seeding, especially in areas too steep for drill seeding or where approved by the BLM, should occur onto a rough seedbed and then should be lightly harrowed, chained or raked to cover the seed. 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 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.

Bureau of Land Management Recommended Seed Mixes

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
Slender wheatgrass		3.0-4.0
Scarlet globemallow		1.0
Gardner saltbush		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
Slender wheatgrass		3.0-4.0
TOTAL		22.0-23.0

[A] Pounds/acre Pure Live Seed. (Source: USDI-PFO 1999 and Glennon 2003)

Standard success criteria would be based on attainment of total vegetation cover. Standard success criteria would be based on attainment of 50% of predisturbance cover in three years and 80% of predisturbance cover in five years. These identified seed mixes could be modified or added to by BLM, as needed or required to meet the RSFO objectives for reclamation.

APPENDIX G

H-6310-1
WILDERNESS INVENTORY AND STUDY PROCEDURES

KINNEY RIM NORTH
WY-030/040

8500 (040/030)
Kinney Rim North

January 2, 2003

Mr. Erik Molvar
Biodiversity Conservation Alliance
P.O. Box 6032
Laramie, Wyoming 82070

Dear Mr. Molvar:

This letter is in response to your "Citizens' Wilderness Inventory" submitted in February, 2002 for the Kinney Rim North area that included over 100,000 acres of Bureau of Land Management (BLM)-administered public lands. You provided information on potential wilderness characteristics in the Rock Springs and Rawlins Field areas.

This information was compared to our existing data bases and field reviews within the Kinney Rim North area. BLM evaluated this information using guidance provided in the Wilderness Inventory and Study Procedures Handbook H-6310-1. As a result of this evaluation, it was determined that the public lands located in the Kinney Rim North area do not have wilderness characteristics

We have attached the inventory evaluation report for your information. We will respond to you in the near future regarding your wilderness submission of the Kinney Rim South area. Please call Kurt Kotter at (307) 328-4200 or myself at (307) 352-0201 if you have any questions regarding this matter.

Sincerely,

/s/ John S. McKee

John S. McKee
Field Manager

Attachments

cc: Kurt Kotter, RFO
Andy Tenney, WO (930)
ATenney:ca:12/31/02:kinneyrimnorthwsa_AT

Inventory Area Evaluation

Name & No. WY-030/040-Kinney Rim North

I. DESCRIPTION:

This unit is comprised of 90.901 acres of BLM-administered public lands located in T.13, 14, 15, and 16 N., R. 98, 99, 100, and 101 W. The area is located approximately 45 miles southeast of Rock Springs in south-central Sweetwater County, Wyoming. The area includes badlands, buttes, rims, flats, and basins. Major geological features include Kinney Rim and Rifes Rim. The landscape is primarily rangelands vegetated by sagebrush, grasses, saltbush, greasewood, and junipers, with occasional cottonwoods and willows along drainages.

Major human uses of the area include livestock grazing management, oil and gas exploration and development, and big game hunting in the fall.

II. Wilderness Character Analysis:

A. Size
Approximate Acres:

Inventory area= 91,120 acres of BLM administered lands (130,689 total acres)

Subunit(s) **A**= Checkerboard- 31,750 acres of BLM
B= 59,370 acres of BLM

Contiguous WSA (or other lands with wilderness character) No

Narrative: The Kinney Rim North Inventory Area was broken into two subunits to incorporate the checker board land pattern and solid block BLM- administered lands.

Area A:

Narrative: This sub-unit lacks 5,000 acres of contiguous public lands because of the alternating sections of private and public lands in a checkerboard land pattern.

Summary: 1. Does the area have at least 5,000 acres of contiguous land or is it of sufficient size to make practical its preservation and use in unimpaired condition?

YES _____ NO __X____

Area B-

Narrative: This sub-unit clearly has sufficient size as to make practical its preservation and use in an unimpaired condition and of size suitable for wilderness management.

Summary: 1. Does the area have at least 5,000 acres of contiguous land or is it of sufficient size to make practical its preservation and use in unimpaired condition?

YES X NO _____

B. Naturalness

Area A-

Narrative: This sub-unit does not meet the size criteria due to lack of contiguous Federal lands therefore naturalness will not be evaluated.

Area B-

Narrative: Evidence of man's activities is found throughout this sub-unit. An improved road leading to an oil and gas well is located in the northwest portion of the area in R 101 W., T. 14 & 15 N. This improved road totals one and a half miles. Another improved access road leading to oil and gas wells is found in the middle of the area located in R. 100 W., T. 14 N. This improved road totals approximately 5 ½ miles. There is an improved County Road (4-77) leading to private land in T. 14 N., R. 101 W. This improved road is approximately one mile long. There are 12 plugged and abandoned gas wells with differing success on well pad and road reclamation. There is evidence of 8 old seismic lines that creates linear intrusions upon the landscape. There are 13 livestock reservoirs located in the sub-unit. There are four livestock water wells located in the sub-unit. There are 10 producing oil and gas wells in the area. There is a horse trap located in Section 8, R. 99 and T. 14 N.

Summary: Does the area generally appear to have been affected primarily by the forces of nature, with the imprint of people's work substantially unnoticeable?

YES _____ NO X

NAME & NO. WY-030/040-Kinney Rim North

C. Outstanding Opportunity for Solitude or Primitive and Unconfined Recreation

1. Solitude

Area A:

Narrative: This sub-unit does not meet the size criteria due to lack of contiguous Federal lands therefore solitude will not be evaluated.

Area B:

This sub-unit lacks outstanding opportunities for solitude because most of the area lacks topographic and vegetative screening to shield user activities from one another.

The sub-unit is bounded by a State Highway on the western boundary, an improved County Road on the southern boundary, and the checkerboard land pattern configuration on the north boundary. The outside influences of man in the form of vehicular traffic and lack of lack of land management controls on private land could influence solitude within the northern part of this sub-unit.

Access to producing oil and gas wells on existing improved roads within the sub-unit impacts the user's ability to escape the sights and sounds of man. The northern portion of the Vermillion Basin Oil and Gas project lies throughout the middle of this area. Activities from oil and gas development would impede upon one's ability to find solitude.

Summary: Does the area have outstanding opportunities for solitude?

YES _____ NO X_____

2. PRIMITIVE AND UNCONFINED RECREATION

AREA A:

Narrative: This sub-unit does not meet the size criteria due to lack of contiguous Federal lands therefore the primitive and unconfined recreation characteristics will not be evaluated.

AREA B:

Narrative: This sub-unit does not possess outstanding opportunities for a primitive and unconfined type of recreation because the area lacks the diversity of possible activities and does not possess one activity of outstanding quality. The area is typical Wyoming rangeland with a lack of intrinsic features such as unique topographic features or diverse vegetation types. The quality of primitive and unconfined recreation opportunities is influenced by man's past and current activities in the form of livestock improvements and oil and gas developments.

Summary: Does the area have outstanding opportunities for a primitive and unconfined type of recreation?

YES _____ NO __X____

D. Supplemental Values

Area A:

Narrative: This sub-unit does not meet the size requirement due to lack of contiguous Federal land therefore the supplemental value characteristics will not be evaluated.

Area B:

Narrative: This area contains remnants of the historic Cherokee Trail and wild horses from the Salt Wells Wild horse Herd Management Area.

Summary: Does the area contain ecological, geological, or other features of scientific, educational, scenic, or historical value?

YES __X____ NO _____

NAME & NO. WY-030/040-Kinney Rim North

III. SUMMARY:

AREA A:

Results of wilderness character analysis:

1. Does the area meet any of the size requirements? _____Yes X____No

The wilderness characteristic inventory for Area A stopped at this point due to the lack of 5,000 acres of contiguous public lands criteria.

AREA B:

Results of wilderness character analysis:

1. Does the area meet any of the size requirements? X_ Yes _____ No
2. Does the area appear to be natural? _____ Yes X____ No
3. Does the area offer outstanding opportunities for solitude or a primitive and unconfined type of recreation? __Yes X____ No
4. Does the area have supplemental values? X____ Yes _____ No

Area A:

IV. Conclusion:

Check one:

_____ The area or apportion of the area has wilderness character.

X_____ The area does not have wilderness character.

AREA B:

Narrative: This sub-unit does not possess outstanding opportunities for a primitive and unconfined type of recreation because the area lacks the diversity of possible activities and does not possess one activity of outstanding quality. The area is typical Wyoming rangeland with a lack of intrinsic features such as unique topographic features or diverse vegetation types. The quality of primitive and unconfined recreation opportunities is influenced by man's past and current activities in the form of livestock improvements and oil and gas developments.

Summary: Does the area have outstanding opportunities for a primitive and unconfined type of recreation?

YES _____ NO __X____

D. Supplemental Values

Area A:

Narrative: This sub-unit does not meet the size requirement due to lack of contiguous Federal land therefore the supplemental value characteristics will not be evaluated.

Area B:

Narrative: This area contains remnants of the historic Cherokee Trail and wild horses from the Salt Wells Wild horse Herd Management Area.

Summary: Does the area contain ecological, geological, or other features of scientific, educational, scenic, or historical value?

YES __X____ NO _____

NAME & NO. WY-030/040-Kinney Rim North

V. Prepared BY: Andy Tenney

Title: Outdoor Recreation Planner Date: 09/23/02

VI. Approved BY:

Title: Rock Springs Field Manager Date: _____

Approved BY:

Title: Rawlins Field Manager Date: _____

Area B:

IV. Conclusion:
Check one:

_____ The area or apportion of the area has wilderness character.

X_____ The area does not have wilderness character.

V. PREPARED BY: Andy Tenney

Title: Outdoor Recreation Planner Date: 9/23/02

VI. Approved BY:

Title: Rock Springs Field Manager Date: _____

Approved BY:

Title: Rawlins Field Manager Date: _____

Inventory Area Evaluation

Name: Kinney Rim North (including parts of Kinney Rim South Located in the Vermillion Basin Oil and Gas Project Area)

DESCRIPTION:

This Unit is comprised of 100,930 acres of BLM administered public lands. The area is located 45 miles southeast of Rock Springs in south-central Sweetwater County, Wyoming. The area includes badlands, buttes, rims, flats, and basins. Major geological features include Kinney Rim and Rifes Rim. The landscape is primarily open undisturbed rangelands vegetated by sagebrush, grasses, saltbush, and greasewood, with occasional cottonwoods and willows along drainages.

The major use of the area is livestock grazing, oil and gas exploration and development, and big game hunting in the fall.

II. Wilderness Character Analysis:

A. Size

Approximate Acres:

Inventory area= 100,930 acres of BLM administered lands
Subunit(s) A= Checkerboard- 34,921 acres of BLM, 37,003 acres of Private and State
B= 43,525 acres of BLM
C= Vermillion Basin Oil and Gas Project Area- 22,484 acres of BLM (12,455 acres in Kinney Rim North, 10,029 acres in Kinney Rim South)

Contiguous WSA (or other lands with wilderness character) No

Narrative: The Kinney Rim North Inventory Area was broken into three subunits to incorporate the checker board land pattern, solid block BLM lands, and the Vermillion Basin Oil and Gas Project area which includes 10,029 acres of the Kinney Rim South Inventory Area.

SUMMARY

Area A: 1. Does the area have at least 5,000 acres of contiguous land or is it of sufficient size to make practical its preservation and use in unimpaired condition?

YES NO X

Area B-
1. Does the area have at least 5,000 acres of contiguous land or is it of sufficient size to make practical its preservation and use in unimpaired condition?

YES X NO

This sub-unit contains 34,921 acres of BLM administered lands that have the basic minimal roadless characteristics.

Area C-

1. Does the area have at least 5,000 acres of contiguous land or is it of sufficient size to make practical its preservation and use in unimpaired condition?

YES NO X

Area C meets the size requirement but does not meet the roadless requirement. Crowned and ditched maintained roads leading to oil and gas wells are found throughout this unit.

B. Naturalness

Area A-

Does not meet the size criteria due to lack of contiguous Federal lands therefore naturalness will not be evaluated.

Area B-

Narrative: Generally, this area appears to have been affected by the forces of nature. However, there are staked access roads that will be upgraded to maintained roads leading to oil and gas drilling activity that could affect this determination. The staked roads are located in R. 101 W., T. 14 & 15 N., and R. 99 W., T. 14 N.. There is also an existing improved road located in R. 100 W., T. 14 N. There are livestock improvements in this area but they remain subordinate on the landscape. The area has large amount of oil and gas leases that are a valid existing right and could affect the naturalness component of this unit.

2. Does the area generally appear to have been affected primarily by the forces of nature, with the imprint of people's work substantially unnoticeable?

YES X NO

Area C-

Narrative: Evidence of man's past and present activities dominate much of the area's landscape. These intrusions include producing oil gas wells, plugged and abandoned oil and gas wells, improved roads to oil and gas wells, and livestock reservoirs.

In the Kinney Rim North part of this unit there are 8 livestock reservoirs, 4 plugged and abandoned oil and gas wells, one producing oil and gas well with a major road leading to it, splitting this unit in half. Another improved road is located in the unit. The majority of the area is leased for oil and gas which could mean there will be additional disturbance in the future such as wells, improved roads, and pipelines.

In the Kinney Rim South portion of this unit, there are parts of two producing oil and gas units with active wells and improved roads leading to them. There are 8 livestock reservoirs located in this portion of the unit. There are 4 producing oil and gas wells located outside the units which have improved access roads leading to them.

2. Does the area generally appear to have been affected primarily by the forces of nature, with the imprint of people's work substantially unnoticeable?

YES NO X

C. Outstanding Opportunity For Solitude Or Primitive And Unconfined Recreation

1. Solitude

Area A:

Narrative: Does not meet the size criteria due to lack of contiguous Federal lands therefore solitude will not be evaluated.

Area B:

Narrative: The area in its present condition contains enough size, topographic screening, and vegetative screening for a user to find a secluded spot. However, the development of existing oil and gas leases could affect these features in the future.

Does the area have outstanding opportunities for solitude?

YES X NO

Area C:

Narrative: This area lacks topographic and vegetative screening to allow a user to a find a secluded spot outside the sights and sounds of man because of the high oil and gas activity in this area.

Does the area have outstanding opportunities for solitude?

YES _ NO X

2. Primitive and Unconfined Recreation

Area A:

Narrative: Does not meet the size requirement due to lack of contiguous Federal land therefore the Primitive and Unconfined Recreation chacteristics will not be evaluated.

Area B:

Narrative: Horse back riding occurs in the area but the evaluation team did not consider this unit to be "outstanding" quality based on the opinion that it is typical Wyoming rangeland,

with typical topographic features. There is also a lack of diversity of primitive and unconfined recreation opportunities in this unit.

Does the area have outstanding opportunities for a primitive and unconfined type of recreation?

YES NO X

Area C:

Narrative: Primitive and Unconfined types of recreation could occur in this unit but would not possess the outstanding quality because of the influence man's activities in the form of oil and gas and livestock improvements.

Does the area have outstanding opportunities for a primitive and unconfined type of recreation?

YES NO X

D. Supplemental Values

Area A:

Narrative: Does not meet the size requirement due to lack of contiguous Federal land therefore the supplemental value chacteristics will not be evaluated

Area B:

Narrative: This area contains remnants of the Cherokee Trail and wild horses from the Salt Wells Wild horse Herd Management Area.

Does the area contain ecological, geological, or other features of scientific, educational, scenic, or historic values?

YES X NO

Area C:

Narrative: This area contains remnants of the Cherokee Trail and wild horses from the Salt Wells Creek Herd Management Area.

Does the area contain ecological, geological, or other features of scientific, educational, scenic, or historic values?

YES X NO

III. SUMMARY:

Results of wilderness character analysis:

AREA A:

1.	Does the area meet any of the size requirements?	Yes	X No

No further evaluation needed.

AREA B:

1.	Does the area meet any of the size requirements?	X	Yes	No
2.	Does the area appear to be natural?	X	Yes	No
3.	Does the area offer outstanding opportunities for solitude? Or a primitive and unconfined type of recreation?	X	Yes	No
4.	Does the area have supplemental values?	X	Yes	No

AREA C:

1.	Does the area meet the any of the size requirements?	X	Yes		No
2.	Does the area appear to be natural?		Yes	X	No
3.	Does the area offer outstanding opportunities for solitude Or a primitive and unconfined type of recreation?		Yes	X	No
4.	Does the area have supplemental values?	X	Yes		No

IV. CONCLUSION

Check one:

AREA A:

The area or a portion of the area has wilderness character.

X The area does not have wilderness character.

AREA B:

X The area or a portion of the area has wilderness character.

The area does not have wilderness character.

AREA C:

The area or a portion of the area has wilderness character.

X The area does not have wilderness character.