Chapter 4

Analysis of Environmental Consequences

4 Analysis of Environmental Consequences

The purpose of this chapter is to analyze and disclose the environmental effects for the Atlantic Rim project including the potential for significant impacts of the *federal action* on the *human environment*. The Council on Environmental Quality regulations for implementing NEPA states that the human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment [40 CFR §1508.14]. The *federal action* in this case is the Proposed Action and the alternatives, which the BLM is reviewing and disclosing impacts in anticipation of issuing a ROD on this project.

Analysis of the alternatives focuses on identifying types of impacts and estimating their potential significance. Throughout this chapter the terms *impact* and *effect* are synonymous. While impacts may be perceived as positive (beneficial) or negative (adverse), those determinations are left for the reader of this document to decide.

Each resource area in this chapter is organized as follows, along with the content of each subsection:

- **Introduction**. In here, the type and range of potential impacts that could occur as a result of the project are described.

- **Impact Significance Criteria**. Significance criteria are developed to gauge the magnitude of an impact on the human environment. Applicable management objectives from the Great Divide RMP are transposed in these subsections as significance criteria. The BLM also took into consideration consistency with the significance criteria found in the Rawlins RMP Draft EIS. Where an anticipated effect is determined to exceed the Atlantic Rim significance criteria, significant impacts (significantly as described in 40 CFR 1508.27) are determined to exist.

- **Direct and Indirect Impacts**. This subsection indicates which impacts are significant relative to the impact significance criteria. It illustrates the impact assessment of the proposed action and alternatives. The following defines direct and indirect impacts:

    - Direct Impacts are effects that are caused by the action and occur at the same time and place. Examples include the elimination of original land use due to the erection of a structure. Direct impacts may cause indirect impacts, such as ground disturbance resulting in resuspension of dust.

    - Indirect Impacts are effects that are indirectly caused by the action. They occur later or are farther removed in distance, but are still reasonably foreseeable and related to the action by a chain of cause and effect. Indirect impacts may reach beyond the natural and physical environment (e.g., environmental impact) to include growth-inducing effects and other effects related to induced changes to resource users (e.g., non-environmental impact).

- **Impacts Summary**. These subsections include a narrative comparison of direct and indirect impacts that would occur under each alternative and between alternatives.

- **Additional Mitigation Measures.** Under these subsections, resource specialists identify additional mitigation measures that could be applied to avoid or reduce impacts above and beyond those listed in the appendices and applicant committed measures. The mitigation measures are in addition to any measures defined in the alternatives.

After assessing direct and indirect impacts in this chapter, cumulative impacts are analyzed in chapter 5. Cumulative impacts from the Proposed Action and the alternatives are analyzed in the context of other ongoing and recently approved activities, recently constructed projects and other past projects, and projects likely to be implemented in the near future reasonably foreseeable future activities (RFFAs) within the vicinity of the ARPA.

4.1 Geology, Mineral, and Paleontology Resources

4.1.1 Introduction

4.1.1.1 Geology

Of the geological features described in section 3.1, the surface environment could be impacted by the Proposed Action and alternatives, which would subsequently affect the geology of the ARPA and cause the geological hazard, mass movement. Removing vegetation or soils, could lead to flooding as a result of decreased infiltration rates and increase overland flow rate. If unmitigated, accelerated erosion that could result may cause gullying in some areas and rapid deposition or siltation in other areas with associated erosion effects. Mass movements, including landslides could be triggered in areas that become oversteepened by erosional removal of slope-supporting material. Altering existing topography, particularly by steepening slopes, could also trigger mass movements and accelerated erosion.

The Proposed Action or its alternatives would not contribute to increased risks of earthquakes. Earthquakes could result in damage to above- ground structures although the likelihood of earthquakes is low as indicated by the absence of recorded epicenters in the ARPA. Buried structures would only be affected if shaking induces ground failure or subsurface rupture. Pyrophoricity and subsidence effects to the geologic (surface) environment have been discussed in chapter 3 and are not considered a concern.

The magnitude of impacts to the geology and geological hazards associated would be reduced by the implementation of mitigation measures for geology, soils, vegetation, and water described in appendix H and adherence to the Great Divide RMP. In addition, no additional mitigation measures would be needed for geology.

4.1.1.2 Mineral Resources

Petroleum and CBNG reserves could be considerably depleted by implementation of the Proposed Action or alternatives within the ARPA. The Proposed Action and its alternatives would approve recovery of natural gas resources, which would cause a loss of reserves in the ground. This would generate private and public revenues if drilling leads to petroleum discovery and development.

No economical locatable mineral resources have been identified in the ARPA. Demand for local sand, gravel, and clinker (disposed of through the mineral materials program) for building

materials for roads, well pads, and other ancillary facilities may increase. Currently permitted sources are considered adequate to meet the demand for mineral materials. Although there is the potential for mining uranium within the ARPA, no development is expected in the near future. The potential for other mineral development, including locatables (gold and other minerals) or coal, is considered low.

4.1.1.3 Paleontology

Excavation of pipeline trenches and construction of well pads, access roads, and ancillary facilities associated with the Proposed Action or its alternatives could result in the exposure and possible destruction of fossil resources of scientific significance either directly as a consequence of construction or indirectly as a result of increased erosion rates. Increased access resulting from development may increase the visibility of fossil resources and lead to increased poaching.

Conversely, excavation of pipelines and construction of project facilities could result in the discovery of new fossil resources. If these newly discovered resources are properly recovered and catalogued into the collections of a museum repository, the Proposed Action and its alternatives could result in a better understanding and knowledge of this resource. In addition, increased access would allow easier access by professional, permitted paleontologists and geologists, who hope to make scientifically significant discoveries.

The magnitude of impacts associated with the loss of fossil resources associated with the Proposed Action or its alternatives would be reduced by the implementation of paleontologic resource mitigation measures described in appendix H and section 4.1.5.3.

4.1.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with geology, mineral, and paleontology resources:

- To provide opportunity for leasing, exploration, and development of oil and gas while protecting other resource values and

- To maintain the integrity of the scientific value of paleontological resources.

The significance criteria for geology, minerals, and paleontology are the following:

1. Impacts to geology would be significant if project implementation results in increased runoff and erosion, leading to mass movement (including landsliding), subsidence, flooding, increased erosion, or in some cases increased deposition or siltation.

2. Depletion of petroleum and CBNG reserves from subsurface reservoirs resulting from the Proposed Action or its alternatives could be considered an impact.

3. Impacts to paleontological resources would be significant if scientifically important fossils are damaged or destroyed directly or indirectly as a result of the Proposed Action or its alternatives.

4.1.3 Direct and Indirect Impacts

4.1.3.1 Proposed Action

Geology

Direct impacts to geology as a result of the Proposed Action would include damage to the surface environment such as alteration of existing local topography that directly or indirectly causes increased risk of mass movements (including landslides) or results in flooding or accelerated erosion or deposition. Indirect impacts to geology would include increased erosion that, if unmitigated, would increase the risk of mass movements including landslides.

Mineral Resources

Other than petroleum and CBNG reserves, inventory of mineral resources in the ARPA revealed no known mineral resources that would be directly or indirectly impacted by implementation of the Proposed Action. Successful field development would result in the ultimate recovery of the natural gas resource from the target formations, under economic conditions favorable to development, and substantially increase petroleum and CBNG. This assumes federal and state permits would be issued for the wells necessary for an efficient operation.

Construction-grade materials are likely to be used from local, as-yet unidentified sources. If development is extensive, local materials may become depleted and additional sources outside of or within the ARPA would need to be identified and used.

Paleontology

Direct impacts to fossils would include damage or destruction of important fossils during construction, with subsequent loss of scientific information. The Proposed Action could result in direct and indirect impacts to fossil resources caused by surface disturbance, especially if disturbances affect geological formations documented in chapter 3 to have a high potential to contain fossils of scientific importance (BLM Paleontology Condition 1 and 2 and Probable Fossil Yield Classes 4 and 5).

However, excavation could reveal fossils of scientific significance that would otherwise have remained buried and unavailable for scientific study. If newly-discovered fossils are properly collected and catalogued into the collections of a museum along with associated geologic data, they would be available for future scientific study. In this way significant consequences, could result from the unanticipated discovery of previously unknown potentially scientifically significant fossils.

4.1.3.2 Alternative A (No Action)

No impacts to geology, minerals, and paleontology would occur under Alternative A.

4.1.3.3 Alternative C

Alternative C would use a more-intensive approval process that might lead to the identification of areas where multiple resources are impacted and where additional mitigation needs to be implemented (See appendix L). This would lessen disturbance in these areas and reduce the potential effects to geology and paleontology. However restrictions or delays in drilling and production might result in the inability to efficiently drain the reservoir.

4.1.3.4 Alternative D

The pace of activities and number of wells drilled under this alternative would be identical to that of the Proposed Action so direct and indirect impacts to geology, minerals, and paleontology remain the same as the Proposed Action. Alternative D would have a goal of limiting disturbance and require successful reclamation during development. The result would be less surface disturbance and unreclaimed land throughout the area. Compared to the Proposed Action, this could reduce the potential effects to geology and paleontology. As with the Proposed Action and Alternative C, to lessen impacts, when paleontological resources are found, work would not proceed until paleontological materials are properly evaluated by a qualified paleontologist.

4.1.4 Impacts Summary

Implementation of the Proposed Action, Alternative C, or Alternative D has the potential for direct and indirect impacts to geology, minerals, and fossil resources. The extent of ground disturbance associated with the Proposed Action, as well as other alternatives, is described in chapter 2 and appendix K. No impacts to the geologic or mineral resources are anticipated under the Proposed Action or Alternatives C or D, with the mitigation discussed in appendix H. Application of this mitigation to all lands (private or public) included in the Proposed Action and its alternatives would further reduce potential direct and indirect impacts to these resources.

The likelihood that significant fossil resources would be damaged or destroyed is reduced with the appropriate pre-disturbance surveys/inventories required in high probability occurrence areas for paleontology (Paleontology Condition 1 and 2 areas and Probable Fossil Yield Class 3, 4, and 5 areas), with case-by-case inventories in these same areas, and as required by mitigation measures identified in appendix H.

4.1.5 Additional Mitigation Measures

4.1.5.1 Geology

Mitigation measures presented in sections 4.3 and 4.4 for soils and water resources would avoid or minimize the potential impacts to the surface geologic environment and lessen the possibility of mass movement, flooding; therefore, no additional mitigation measures are required.

4.1.5.2 Minerals

No additional mitigation measures that would address oil and gas resource depletion are proposed.

4.1.5.3 Paleontology

With implementation of mitigation measures identified in appendix H, no additional mitigation measures are required. In addition, locations found to yield scientifically important fossils would not be reclaimed prior to a review by a qualified paleontologist.

4.2 Air Quality

Direct and indirect air quality impacts were analyzed to determine potential near-field and far-field ambient air pollutant concentrations, far-field visibility (regional haze), far-field atmospheric deposition (acid rain), and in-field (within the ARPA) concentrations.

This air quality impact assessment is based on the best available engineering data and assumptions, meteorology data, and dispersion modeling procedures, as well as professional and scientific judgment. Assumptions representing most likely operating conditions were incorporated into the analysis whenever possible. For example, for the far-field analysis, compression in the field was assumed to operate at 90 percent of permitted capacity. Where no reliable, most likely operating projections were available, other parameters were assumed to occur at maximum proposed levels. For example, potential impact assessments for the Proposed Action assume that all proposed wells would be productive (no dry holes).

Air pollution potential impacts are limited by state and federal regulations, standards, and implementation plans established under the Clean Air Act and administered by the applicable air quality regulatory agency—specifically, the WDEQ-AQD and the EPA. Colorado, and other regional states, have similar jurisdiction over potential air pollutant emissions sources in those states, and those sources may have a cumulative potential impact when combined with WDEQ-AQD-regulated sources. The applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees, and control devices prior to construction and operation. The U.S. Congress (through the Clean Air Act Section 116) authorizes these local, state, and tribal air quality regulatory agencies to establish air pollution control requirements of equal or greater stringency than federal requirements. Any proposed emissions source is required to undergo a permit review by the applicable air quality regulatory agency before construction can begin. The agencies review the specific air pollutant emission sources proposed and, depending upon the magnitude of air emissions and other factors, may require additional site-specific air quality analysis and/or additional emission control measures (including a Best Available Control Technology [BACT] analysis and determination) to ensure protection of air quality.

Under FLPMA and the Clean Air Act, BLM cannot authorize any activity that does not conform to all applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, and implementation plans. An air quality impact assessment technical support document was prepared to document analyses of potential impacts from the proposed development alternatives, as well as other reasonably foreseeable emission sources within a defined cumulative analysis area. The Atlantic Rim Natural Gas Project and the Seminoe Road Gas Development Project Air Quality Technical Support Document (appendix F) provides additional detail on this air quality evaluation and is available for review at the BLM RFO.

4.2.1 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with air quality resources:

- To prevent the deterioration of air quality beyond applicable local, state, or federal standards, and to enhance air resources where practicable and

- To prevent impairment of important scenic values that may be caused by declining air quality.

The significance criteria for potential air quality impacts include state and federally enforced legal requirements to ensure that air pollutant concentrations would remain within specific allowable levels, as well as adherence to the aforementioned RMP and land use plan goals and objectives. Potential impacts are considered significant if:

1. Potential total near-field concentrations are greater than WAAQS or NAAQS;

2. Potential total far-field concentrations are greater than applicable state ambient air quality standards or NAAQS;

3. Potential cumulative near-field concentrations are greater than PSD Class II increments;

4. Potential cumulative far-field concentrations in parks and wilderness areas in the region are greater than PSD Class I increments;

5. Potential decrease in visibility in parks and wilderness areas in the region is greater than Federal Land Managers' Air Quality Related Values Workgroup (FLAG), USDA-FS, or NPS thresholds;

6. Potential decrease in ANC in sensitive lakes in the region is greater than levels of acceptable change LAC;

7. Potential increases in deposition from the project are greater than deposition analysis thresholds (DAT); or

8. Potential cumulative total deposition is greater than USDA-FS levels of acceptable change.

Legal requirements include the NAAQS and WAAQS, which set maximum limits for several air pollutants, and PSD increments, which limit the incremental increase of certain air pollutants (including nitrogen dioxide [NO_2], PM_{10}, and sulfur dioxide [SO_2]) above legally defined baseline concentration levels. These standards and increments were presented in table 3-6.

4.2.2 Direct and Indirect Impacts

4.2.2.1 Analysis Assessment of Direct and Indirect Impacts

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

Where legal limits have not been established, the BLM uses the best available scientific information to identify thresholds of significant potential impacts. Thresholds of levels of concern have been identified for Hazardous Air Pollutants (HAP) exposure, incremental cancer risks, a "just noticeable change" in potential visibility impacts, and potential atmospheric deposition impacts to sensitive lake water chemistry. These thresholds or levels of concern are described later in this chapter.

Air quality potential impacts from the project would occur from pollutants emitted during construction (due to potential surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well completion and testing, and drilling rig and vehicle engine exhaust) and production (natural gas well-site production equipment, reciprocating pipeline compression engine exhausts, vehicle traffic engine exhausts, and fugitive dust). Pollutants emitted from these activities include PM_{10}, $PM_{2.5}$, nitrogen oxides (NO_x), carbon monoxide (CO), SO_2, volatile organic compounds (VOCs), and HAPs (benzene, toluene, ethylbenzene, xylene, n-hexane, and formaldehyde). Ozone (O_3) may also develop from NO_x and VOC emissions. The amount of air pollutant emissions during construction and production may be controlled in part by BACT requirements implemented by WDEQ-AQD. Actual air quality potential impacts from these air pollutants would depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, relative humidity, etc.).

The assessment of direct project potential impacts included a near-field analysis and a far-field analysis. The near-field analysis assessed direct project potential impacts in the immediate vicinity of project activities resulting from a single phase of construction or production reflective of maximum emissions. The far-field analysis assessed direct project potential impacts from field-wide project emissions at in-field locations within the ARPA and at far-field locations (i.e., sensitive Class I and Class II areas). The far-field analysis also assessed regional emission sources located within the model domain illustrated on map M-8 to predict cumulative potential impacts at in-field and far-field locations. While there may be additional gas processing or transmission requirements due to the development of this and other natural gas projects regionally and nationally, the potential effects of these developments are not quantified herein since these developments are speculative and would likely require additional WDEQ-AQD permitting if they eventually are proposed. The near-field and far-field potential impact analyses were completed for the Proposed Action and Alternative A.

Near-Field Analysis

The near-field analysis analyzed direct project potential impacts within the ARPA and used air pollutant emission rates, which were calculated for all phases of construction and production based on WDEQ-AQD guidance. The AERMOD model was used to assess modeled impacts from the phase of either (1) single-well construction or (2) field production that produced the highest emissions. The near-field analysis for PM_{10}, $PM_{2.5}$, and SO_2 focused on localized modeled impacts from construction and drilling activities at a single well pad. The near-field analysis for NO_x, CO, and HAPs modeled 2,000 developed wells to reflect the maximum number of wells in production, of which 10 percent were considered conventional natural gas wells and the remaining 90 percent CBNG wells. NO_x, CO, and formaldehyde modeling included emissions from 12 compressor stations to be located within the project area: Blue Sky, Brown Cow, Cow Creek, Doty Mountain, Jolly Roger, Muddy Mountain, Red Rim, Sun Dog, and four additional planned stations.

A near-field analysis of O_3 potential impacts was conducted separately. O_3 is formed through the chemical reaction of NO_x and VOCs within the atmosphere in the presence of sunlight. A nomograph developed from the Reactive Plume Model (RPM) (Scheffe 1988) was used to estimate the maximum ozone potential impacts based on NO_x and VOC emissions generated from the project. Emissions from a representative localized production area consisting of 17 conventional natural gas wells and the Jolly Roger compressor station were used in this analysis.

Acute (short-term) HAP potential impacts were modeled by assuming that a person would not persistently remain at a location closer than 100 meters (328 feet) from a well pad or a compressor station due to site operations safety considerations. Long-term (chronic) health-based HAP potential impacts and long-term (chronic) cancer risk were modeled using the realistic estimate of long-term exposure, which assumed that a person would not be closer than the nearest residence just west of the ARPA, located 5.5 miles from a well pad or compressor site, when averaged over a lifetime. Two estimates of cancer risk were made: (1) one that corresponds to a most-likely-exposure (MLE) over a national residency average of 9 years with some time spent away from home, and (2) one reflective of the maximally-exposed-individual (MEI) residing at one location for a lifetime with no time spent away from home. The estimated cancer risks were calculated based on EPA (1997) unit risk factors for carcinogenic constituents.

Far-Field Analysis

The far-field analysis used the EPA CALMET/CALPUFF modeling system to predict maximum air quality impacts at mandatory federal PSD Class I and other sensitive PSD Class II areas, as well as designated acid-sensitive lakes within these areas. The analysis also included a potential air quality impact assessment at in-field locations within the ARPA to determine maximum concentrations that could occur from all sources operating simultaneously in the field.

The air emissions modeled for project and non-project sources in the far-field analysis are presented in table 4-1. The modeling scenario developed for the Proposed Action assumed the maximum field emissions that could potentially occur concurrently during the final year of construction representing the maximum annual construction activity rate combined with nearly full-field production. Maximum emissions scenarios include production emissions (producing well sites and ancillary equipment including compressor stations) and construction emissions (drilling rigs and associated traffic), both occurring continuously over the year. Compressor stations were modeled at currently known or anticipated locations within the ARPA, and well sites and construction activities were modeled evenly throughout the entire ARPA. Details on modeling methodology are presented in the Air Quality Technical Support Document (appendix F).

Predicted pollutant concentrations were compared to applicable ambient air quality standards, PSD Class I and Class II increments, and were used to assess potential impacts to AQRVs—visibility (regional haze) and atmospheric deposition—at sensitive PSD Class I and II areas. The PSD Class I areas and sensitive Class II areas analyzed in the far-field analyses include:

- The Bridger Wilderness Area (Class I),
- The Fitzpatrick Wilderness Area (Class I),
- The Popo Agie Wilderness Area (Class II),
- The Wind River Roadless Area (Class II),
- The Mount Zirkel Wilderness Area (Class I),

- The Rawah Wilderness Area (Class I),
- The Savage Run Wilderness Area (Federal Class II, Wyoming Class I),
- Rocky Mountain National Park (Class I), and
- Dinosaur National Monument (Federal Class II, Colorado Class I [SO2 only]).

Table 4-1. Project and Non-Project Emissions (Tons/Year) Included in Far-Field Analysis.[1]

Source Category	NO_x	SO_2	PM_{10}	$PM_{2.5}$
Project Sources				
Proposed Action	1,278.5	58.2	780.4	170.6
Alternative A (No Action)	0.0	0.0	0.0	0.0
Non-Project Sources				
RFD	6,224.2	55.5	48.1	48.1
RFFA	4,568.8	-1,394.3	-833.6	-330.0
State-permitted	2,868.0	118.2	-14.8	-133.1

Note:
[1] Non-project emissions sources (RFD and RFFA) are described in section 4.2.3

Because emissions sources under the Proposed Action consist of many small sources spread out over a large area, discrete visible plumes are not likely to impact the distant sensitive areas. However, visible plumes may be noticeable within the ARPA and from nearby travel routes, especially during flaring upset conditions. Nonetheless, the potential for cumulative visibility potential impacts (increased regional haze) is a concern. Regional haze is caused by light scattering and light absorption by fine particles and gases. Potential changes to regional haze are calculated in terms of a perceptible "just noticeable change in visibility" when compared to background conditions. The BLM considers that a 1.0 dv change would be a reasonably foreseeable significant impact, although there are no applicable local, state, tribal, or federal regulatory visibility standards. Other federal agencies are using a 0.5 dv change as a screening threshold for significance. The USDA-FS and NPS compare direct project potential impacts to the 0.5 dv level and those comparisons are included in the Air Quality Technical Support Document (appendix F).

The NPS, USDA-FS, and USFWS have published the FLAG Phase I Report (FLAG 2000) that prescribes a process for assessing the potential impacts of new and existing sources on AQRVs including visibility. The FLAG Report describes a cumulative potential impacts analysis of new growth sources (defined as PSD increment-consuming sources) on visibility. If visibility impairment from a proposed new source, in combination with cumulative new source growth, is less than an extinction of 10 percent (1.0 dv) for all days, the federal land managers would likely not object to the proposed new source. However, if predicted visibility impacts are above the visibility threshold, factors such as the magnitude of dv change, frequency, seasonal variations, and meteorological conditions may be considered when assessing the significance of predicted impacts.

A 1.0-dv change is considered a small but noticeable change in haziness as described in the EPA regional haze regulations (40 CFR §51.300). One dv is defined as approximately equal to a 10-percent change in the extinction coefficient (corresponding to a 2–5-percent change in contrast for a black target against a clear sky at the most optically sensitive distance from an observer). This is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory Class I areas. However, this NEPA analysis is not designed to predict potential visibility impacts for specific views in mandatory Class I areas based on specific project designs, but to rather characterize reasonable foreseeable visibility conditions that are representative of a large geographic region based on reasonable emission source assumptions. This approach is consistent with the nature of regional haze and the requirements of NEPA.

Potential changes in regional haze at PSD Class I and sensitive PSD Class II areas were estimated by comparing CALPUFF modeled impacts to background visibility conditions in the Class I or sensitive Class II area. This comparison was performed using two different representations of background visibility conditions. One method used visibility values provided in the FLAG Report for each Class I area to represent natural background visibility. The second method used estimated background visibility values from an analysis of recent long-term monitored data (1988–2002) from the IMPROVE program. This analysis consisted of estimating visibility parameters for representative Class I areas corresponding to the monitoring period of record quarterly average of the 20 percent best visibility days.

Fourteen lakes within the sensitive PSD Class I and Class II Wilderness Areas were identified as being sensitive to atmospheric deposition. These lakes are those for which the most recent and complete data are available, and include:

- Deep Lake in the Bridger Wilderness Area,
- Black Joe Lake in the Bridger Wilderness Area,
- Hobbs Lake in the Bridger Wilderness Area,
- Upper Frozen Lake in the Bridger Wilderness Area,
- Lazy Boy Lake in the Bridger Wilderness Area,
- Ross Lake in the Fitzpatrick Wilderness Area,
- Lower Saddlebag Lake in the Popo Agie Wilderness Area,
- West Glacier Lake in the Glacier Lakes Ecosystem Experiments Site (GLEES),
- Lake Elbert in the Mount Zirkel Wilderness Area,
- Seven Lakes in the Mount Zirkel Wilderness Area,
- Summit Lake in the Mount Zirkel Wilderness Area,
- Island Lake in the Rawah Wilderness Area,
- Kelly Lake in the Rawah Wilderness Area, and
- Rawah Lake #4 in the Rawah Wilderness Area.

The NPS (2001) has identified DATs for total nitrogen and sulfur deposition in the western U.S., which are defined as 0.005 kg/ha-yr for both N and S. The DAT is used as an analysis threshold for evaluating the potential impacts from project-related emissions. The exceedences of this threshold trigger a management concern, but are not necessarily indicative of an adverse impact (NPS 2004). The USDA-FS (Fox et al. 1989) has defined 5 kg/ha-yr for sulfur and 3 kg/ha-yr for nitrogen as LOCs for potential total deposition impacts, and these are used for comparison of potential impacts from cumulative source emissions. It is understood that the USDA-FS no longer considers these LOCs to be protective; however, in the absence of alternative FLM-approved values, comparisons to these levels are made. The USDA-FS Rocky

Mountain Region has also developed a screening method (USDA-FS 2000) that identifies a LAC in lake chemistry. The LACs are (1) no more than a 10-percent change in ANC for lakes with an existing ANC of 25 µeq/L or greater and (2) no more than a 1-µeq/l change for extremely acid sensitive lakes where the existing ANC is below 25 µeq/L. Of the fourteen lakes identified by the USDA-FS as acid sensitive, Upper Frozen and Lazy Boy lakes are considered extremely acid sensitive.

4.2.2.2 Proposed Action

Near-Field Impacts

The single phase of construction or production proposed as part of the Proposed Action that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of the Proposed Action modeled were PM_{10} and $PM_{2.5}$ during construction of a well pad; SO_2 from drilling activities; and NO_2, CO, and HAP from production wells and compressor stations.

The predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 are presented in table 4-2 for comparison to the NAAQS and WAAQS. As discussed in section 3.2.2, as of June 15, 2005 there is no federal or state 1-hour ozone standard that applies to Wyoming, and as of December 18, 2006 the 24-hour $PM_{2.5}$ standard will be lowered to 35 micrograms per cubic meter (ug/m3). In addition, the number of allowable exceedances for the 24-hour $PM_{2.5}$ standard will increase from one to seven (on average over three years). Therefore, BLM will now compare the eighth maximum predicted 24-hour $PM_{2.5}$ impact to the NAAQS as a "threshold of significance." The second maximum predicted 24-hour $PM_{2.5}$ impact is shown on table 4-2 and is below the new standard to be applied this December.

Maximum predicted concentrations of NO_2, CO, SO_2, PM_{10} and $PM_{2.5}$ were added to the ambient background pollutant concentrations, provided in table 3-6, for comparison to ambient standards. O_3 maximum predicted concentrations were added to the average hourly background O_3 conditions monitored as part of the Green River Basin Visibility Study (ARS 2002) versus second high maximum values as presented in table 3-6. The average value (75.2 µg/m^3) is consistent with (slightly higher than) the background ozone concentration of 62.6 µg/m^3 that was used in the RPM modeling to derive the Scheffe nomograph. In addition, the Scheffe method is a screening level modeling tool, and as such, it is overly conservative to add highest, second highest measured concentrations to screening level estimates.

Table 4-2. Maximum Predicted Near–Field Impacts from Project Sources–Comparison to Ambient Air Quality Standards, Atlantic Rim Natural Gas Project.

Pollutant	Averaging Period	Maximum Predicted Impact of All Phases (µg/m^3)	Background Concentration (µg/m^3)	Total Predicted Impact (µg/m^3)	NAAQS/ WAAQS (µg/m^3)	Percent of NAAQS/ WAAQS
NO_2	Annual	11.5	3.4	14.9	100	15
PM_{10}	24-Hour	20.8	33	53.8	150	36
	Annual	3.7	16	19.7	50	39
$PM_{2.5}$	24-Hour	7.0	13	20.0	65	31
	Annual	1.0	6	5.0	15	33
CO	1-Hour	222.6	3,336	3,559	40,000	9
	8-Hour	85.9	1,381	1,467	10,000	15

Table 4-2. Maximum Predicted Near–Field Impacts from Project Sources–Comparison to Ambient Air Quality Standards, Atlantic Rim Natural Gas Project.

Pollutant	Averaging Period	Maximum Predicted Impact of All Phases (µg/m^3)	Background Concentration (µg/m^3)	Total Predicted Impact (µg/m^3)	NAAQS/ WAAQS (µg/m^3)	Percent of NAAQS/ WAAQS
SO_2	3-Hour	20.2	132	152.2	1,300	12
	24-Hour	9.7	43	52.7	365 / 260	14 / 20
	Annual	3.2	9	12.2	80 / 60	15 / 20
O_3	1-Hour	23.0	75.2	98.2	235	42
	8-Hour	16.1	75.2	91.3	157	58

Predicted impacts from Proposed Action source emissions were shown to be below the applicable WAAQS and NAAQS. Table 4-3 presents a comparison of maximum predicted NO_2 impacts to the PSD Class II increment for NO_2. All NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD increment consumption analysis.

Table 4-3. Maximum Predicted Near-Field Impacts from Project Sources—Comparison to PSD Increments.

Pollutant	Averaging Period	Maximum Predicted Impact of All Phases (µg/m^3)	PSD Class II Increment (µg/m^3)
NO_2	Annual	11.5	25

When reviewing the predicted near-field impacts, it is important to understand that the results reported reflect the maximum pollutant emission rates calculated for the field and that the resulting concentrations are combined with monitored background ambient pollutant concentrations. Monitored background air pollutant concentrations were assumed to occur throughout the life-of-project at all locations year-round. In addition, the maximum predicted air quality impacts from ARPA emission sources would occur in the vicinity of the ARPA because potential impacts typically lessen with distance from an emissions source; potential impacts at locations more distant from the ARPA would be less than the predicted maximum concentrations. Finally, total air pollutant concentrations were assumed to be the sum of the maximum modeled concentration and the background concentration. This methodology is used for both long-term and short-term averaging periods. For short-term averaging periods, these maximum concentrations may occur under very different meteorological conditions and may not occur simultaneously.

Table 4-4 summarizes modeled HAP impacts based on emissions representative of the Proposed Action. All modeled acute and chronic impacts are below applicable health-based guidelines for the non-cancer compounds. Calculated cancer risk from formaldehyde and benzene are shown in table 4-5. Both the incremental risk from benzene and formaldehyde and the combined risk are less than the level of acceptable cancer risk of 1×10^{-6} for both the MLE and MEI scenarios.

Far-Field Impacts

Impacts from the Proposed Action maximum emissions scenario, which includes the last year of field construction, and nearly the full field in production, were modeled with CALPUFF. The emissions modeled are provided in table 4-1. The maximum predicted concentrations, when added to ambient background pollutant concentrations, are below all applicable WAAQS, California Ambient Air Quality Standards (CAAQS), NAAQS, and PSD increments.

Direct visibility potential impacts from Proposed Action sources were predicted to be below the "just noticeable visibility change" (1.0 dv) at all sensitive wilderness areas using both the FLAG and IMPROVE background visibility data. The maximum predicted visibility change (0.2 dv) was predicted to occur at both the Savage Run Wilderness Area (both FLAG and IMPROVE background data) and Dinosaur National Monument (IMPROVE data only).

Direct project source emissions from the Proposed Action would result in an ANC change less than the LAC at analyzed acid-sensitive lakes. The predicted maximum sulfur and nitrogen deposition potential impacts from Proposed Action sources are below the 0.005 kg/ha-yr DAT at all the sensitive PSD Class I and Class II areas.

Table 4-4. Maximum Modeled HAP Impacts from Project Sources.

Hazardous Air Pollutant	Averaging Period	Maximum Modeled Impact (µg/m^3)	Health Based Standards (Acute RELs and RfCs) (µg/m^3)
Benzene	1-Hour	926	1,300
	Annual	0.02	30
Toluene	1-Hour	1,414	37,000
	Annual	0.03	400
Ethylbenzene	1-Hour	154	35,000
	Annual	0.003	1,000
Xylenes	1-Hour	823	22,000
	Annual	0.02	430
n-Hexane	1-Hour	3832	39,000
	Annual	0.08	200
Formaldehyde	1-Hour	11	94
	Annual	0.003	9.8

Notes:
RELs – Reference Exposure Limits
RfCs – Reference concentrations for chronic inhalation

Table 4-5. Long-term MLE and MEI Cancer Risk Analyses.

Analysis	HAP Constituent	Modeled Concentration ($\mu g/m^3$)	Unit Risk Factor $1/(\mu g/m^3)$	Exposure Adjustment Factor	Cancer Risk
MLE	Benzene	0.019	7.8×10^{-6}	0.0949	1.39E-08
	Formaldehyde	0.0030	1.3×10^{-5}	0.0949	3.66E-09
Total Combined Risk					**1.8×10^{-8}**
MEI	Benzene	0.019	7.8×10^{-6}	0.71	1.04E-07
	Formaldehyde	0.0030	1.3×10^{-5}	0.71	2.74E-08
Total Combined Risk					**1.3×10^{-7}**

In-Field Impacts

The CALPUFF model was also used to predict maximum air quality impacts from field-wide emissions sources at locations within and adjacent to the ARPA. The model-predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ at locations within and nearby the ARPA were added to monitored background concentrations and compared to applicable ambient air quality standards. The estimated project-related potential impacts are below applicable ambient air quality standards.

4.2.2.3 Alternatives A, C, and D

Air quality impacts in the ARPA would continue under the No Action Alternative (Alternative A) from previously approved natural gas development activities and could potentially occur under Alternatives C or D in the future. However, air impacts from each of these three alternatives would be less than or equivalent to the Proposed Action. Thus, none of the impacts would exceed the significance criteria in section 4.2.1.

4.2.3 Air Quality Monitoring and Mitigation

Potential air quality impacts from the Atlantic Rim project were estimated to be below applicable air quality standards (table 4-2). Potential O_3 concentrations were estimated by the Scheffe method, which was considered by the inter-agency air quality team to be a reasonable tool and an acceptable ozone method at the time the air quality analyses was conducted.

4.2.3.1 Monitoring

WDEQ established an air quality monitoring station on land owned by Anadarko Petroleum near Wamsutter, Wyoming in March of 2006 to monitor concentrations of NO_x, O_3, PM_{10} and SO_2. In cooperation with WDEQ, the Operators would finance and operate additional air quality concentration monitoring, including O_3, in the RFO area. BLM would work cooperatively with WDEQ, EPA and the operators to maintain and enhance concentration monitoring in the RFO area, including monitoring required to represent impacts due to emissions from the Atlantic Rim field.

4.2.3.2 Mitigation

If in the future air monitoring were to show O_3 exceedances that were attributable at least in part to sources in the Atlantic Rim field, BLM would consult with WDEQ and EPA to determine whether adaptive management would be needed to mitigate impacts.

4.3 Soils

4.3.1 Introduction

Potential impacts resulting from construction/installation of drill pads, pipelines, ancillary facilities, and access roads would include:

- Loss/reduction of vegetation cover and biological soil crusts,
- Exposure of vulnerable sub-surface soil profiles,
- Loss/reduction of sub-surface biological components (i.e., earthworms, nematodes),
- Undesirable mixing of soil horizons,
- Soil compaction, and
- Loss of topsoil productivity.

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

4.3.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state land use plans (WSLUC 1979) prescribe the following management objectives associated with soil resources:

- To maintain soil cover and productivity where they are adequate and to increase soil cover and productivity where they are in a downward trend and

- To maintain or improve soil stability, within the potential of the ecological site, to insure adequate water infiltration, optimal plant growth, and minimal surface runoff.

The following criteria serve as a basis to assess the intensity, duration, and magnitude of potential soil impacts associated with implementation of the Proposed Action and action alternatives. Soil impacts would be significant given the following:

1. Soil loss greater than 2 tons per acre per year above base levels in areas attributed to surface disturbance after reclamation,

2. Interim reclamation is unsuccessful within 5 years of implementation, or

3. Soil productivity is reduced to a level that prevents the disturbed area from recovering to pre-disturbance soil/vegetation productivity levels.

4.3.3 Direct and Indirect Impacts

4.3.3.1 Proposed Action

Construction and operation of wells, pipelines, roads, and facilities in the ARPA associated with the Proposed Action would result in impacts to the soil resource by:

- Removal/damage of existing native vegetation and surface litter thus increasing wind erosion potential, increasing raindrop impacts to exposed soils and water erosion potential, and increasing soil surface temperature;
- Removal/damage of biological soil crusts;
- Removal/damage of topsoil and sub-soil fauna (macro- and microorganisms);
- Compaction of soils;
- Mixing of topsoil horizons, especially when mixed with sub-soils of high salt content; thus increasing topsoil salinity content;
- Increasing potential for undesirable (invasive/noxious/poisonous) plant invasion and establishment;
- Increasing potential for sedimentation/salt loads to the watershed, including stock ponds; and
- Decreasing topsoil productivity.

As described in section 3.3, most soils in the ARPA have been mapped and sensitive soils identified. Implementation of the Proposed Action may occur in/on soils that have severe existing limitations. Table 3-10 summarizes the total area (acres) that may be affected by these limiting factors identified in the ARPA.

Because soil mapping units indicate sensitive soils are widely distributed throughout the ARPA, total avoidance of these areas is not feasible. Minimizing or avoiding all together the construction of ancillary facilities in areas identified to contain sensitive soils would reduce impacts to an acceptable level. Strict adherence to Required Best Management Practices (appendix H), the RMP, Best Management Practices for Non-Point Source Pollution (appendix J), and the Reclamation Plan (appendix B) would minimize impacts to sensitive soils.

Over the estimated 20-year development phase, the Proposed Action is estimated to disturb a total of 15,800 acres which represents about 6 percent of the total land surface of the project area. During the projected 30–50 year life-of-project, the initial disturbed acreage would be gradually reduced to about 6,200 acres dependent upon time required for successful reclamation. Approximately 1,170 total well locations would be developed in the first 6 years. The entire project area would be developed over a 20-year period, with approximately 90 percent of the CBNG wells and 75 percent of the conventional wells being drilled within 15 years.

A large portion of the project area would be difficult to re-vegetate due to high erosion hazard potentials and poor topsoil. Some areas of clayey soils, sandy soils, and slopes greater than 25 percent would be avoided by final site selection during the on-site inspections for each year's development plan.

In general, the extent of these impacts to the soil resource would be influenced by the success of mitigation and reclamation efforts. Reclamation success, in part, depends on the amount of surface area disturbed, quality of topsoil salvaged, stockpile/redistribution methods in disturbed areas, precipitation, soil type, and moisture availability.

Despite the difficulty of establishing vegetation on sites with less than 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. The reclaimed areas within the interim drilling pods have not shown this success to date. There are many disturbed areas with increased erosion, weed infestations, and low native vegetation cover. Erosion could be reduced and reclamation success improved, assuming construction, maintenance and operation of well pad sites and associated disturbances are in accordance with mitigation measures summarized in appendix H, BMPs, and RMP requirements. An increased pace of development would intensify the rate of soil exposed and the need for reclamation. Many areas would exceed the significance criteria for soils; therefore the project would exceed the significance criteria.

Surface-disturbing activities have the potential to disturb or destroy biological soil crusts, if they are present. Loss of biological soil crusts by burying is inevitable with road construction, trenching, and other operations that remove vegetation and top soil. Disturbance 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 resulting in slowing or preventing crust recovery and increasing erosion potential. Vehicles with high-flotation tires (e.g., all-terrain vehicles or ATVs) exert less force to the soil surface but may still disrupt crusts by rapid turns which shear the topsoil. A single pass across soils by a vehicle can crush biological soil crusts resulting in a long-term loss; the length of time necessary to allow recovery is estimated at 50–100 years (Belnap et al. 2001). If crusts are removed or buried, recovery time is anticipated to be longer.

4.3.3.2 Alternative A (No Action)

Under the no action alternative, direct and indirect disturbance of soil and crusts would continue under already approved actions, until those projects are completed. The remainder of the project area soils would remain unaffected. Reclamation, erosion, and weed control during the interim drilling period to date is a concern based on current reclamation success. BLM will focus on adaptive management of disturbance to improve reclamation success.

4.3.3.3 Alternative C

Implementing Alternative C would have similar impacts to the Proposed Action, but additional mitigation proposed for soils and other resources would limit the initial disturbance acres on sensitive sites to less than 20 acres and four well pads per section. Examples of some sensitive sites are soils with high runoff potential and big game crucial winter range. These mitigation measures would reduce the total acres disturbed by 68 percent on areas with federal minerals

ownership compared to the Proposed Action. Other mitigation measures proposed would further reduce erosion from disturbed sites.

These benefits would be realized to the greatest extent in the central and southern portions of the ARPA where there is a preponderance of BLM lands. The extreme southern portion and the northern half would realize some benefit of these additional mitigations, but their effectiveness would be reduced due the lack of equivalent mitigation on private and state lands.

Alternative C will not only reduce effects based on lower surface disturbance extents, but also due to the influence of the other development protection measures and the reduced number of siting choices that need to be made. Where only 4 well pads per section are allowed, the best four would be chosen as compared to finding 8 locations per section.

This reduction in disturbance acres and application of development protection measures would directly reduce the acreage and environmental impacts of this alternative which would not exceed the significance criteria as a result of the project. Although some localized areas still would exceed the criteria, overall, the project would not exceed the significance criteria.

4.3.3.4 Alternative D

Implementing Alternative D would have a goal of limiting the acreage disturbed compared to the Proposed Action of an average of approximately 20 percent across the ARPA and more within Category A areas (map M-7). Total disturbance acres would be reduced compared to the Proposed Action, but with very little disturbance in avoidance areas. Alternative D would establish a project-wide surface disturbance goal of 6.5 acres/well, with a disturbance goal in Category A areas (Map M-7) less than 6.5 acres/well. Soils in avoidance areas would generally be protected, unless influenced by activities adjacent to these sites. Overall, the impacts to soils would be the same as with the Proposed Action, but occur over reduced disturbance acreages and would still exceed the significance criteria.

4.3.4 Impacts Summary

Implementing the Proposed Action or Alternative D, would reduce potential impacts, assuming construction, maintenance, and operation of well pad sites and associated disturbances are in accordance with BMPs and the RMP requirements. Many areas would still exceed the significance criteria for soils; therefore, the project would exceed the significance criteria under these alternatives.

Implementing Alternative C would reduce direct impacts to sensitive soils compared to the Proposed Action, by 68 percent on federal mineral leases (66 perecent of the ARPA). This reduction in disturbance acres and application of additional erosion control measures (appendix L) would directly reduce the acreage which would exceed the significance criteria as a result of the project. Although some localized areas still would exceed the criteria, overall, the project would not exceed the significance criteria.

4.3.5 Additional Mitigation Measures

There is no additional mitigation proposed under the Proposed Action or Alternative D. Mitigation measures listed in appendix H apply to all alternatives. Additional mitigation proposed under Alternative C is located in appendix L.

4.4 Water Resources

4.4.1 Introduction

The Clean Water Act of 1987, as amended (33 United States Code 1251) established objectives to restore and maintain the chemical, physical, and biological integrity of the nation's water. The act also requires permits for point source discharges to navigable waters of the United States and the protection of wetlands, and it includes monitoring and research provisions for protection of ambient water quality. The State of Wyoming implements permitting and monitoring requirements for the Wyoming Pollutant Discharge Elimination System (WYPDES), operation of injection wells, groundwater protection requirements, prevention and response requirements for spills, and Water Quality Standards for Salinity in the Colorado River system as recommended by the Colorado River Basin Salinity Control Forum and adopted by WDEQ as a member of the forum.

Protection of Wetlands (EO 11990) requires federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Floodplain Management (EO 11988) provides for the restoration and preservation of national and beneficial floodplain values, and enhancement of the natural and beneficial values of wetlands in carrying out programs affecting land use. Potential project-related depletions to the Little Snake River are considered with regard to the Yampa River Basin Management Plan and the Upper Colorado River Endangered Fish Recovery Program (1999) for Colorado River native fish downstream from the project area (http://www.r6.fws.gov/crrip/).

Surface discharge, as a method of disposal, from Federal Mineral Leases is subject to BLM approval to the point of discharge. Once surface discharge is approved, the operations from the point of discharge downstream are under the jurisdiction of the State of Wyoming.

> All produced water from Federal/Indian leases must be disposed of by (1) injection into the subsurface; (2) into pits; or (3) other acceptable methods approved by the authorized officer, including surface discharge under NPDES permit. Injection is generally the preferred method of disposal. Operations from the point of origin to the point of discharge are under the jurisdiction of the BLM. Operations from the point of discharge downstream are under the jurisdiction of EPA or the Primacy State. 43 CFR 3162.5-1(b)

Some of the regulations described above require that certain permits/authorizations be obtained from the State of Wyoming, the BLM or other Federal Agencies including WYPDES permits for surface discharge of produced water; Applications for Permits to Drill, Federal Lease Obligations, development of a surface runoff, erosion, and sedimentation control plans; injection well permitting; oil spill containment and contingency plans; as well as Clean Water Act (CWA) Section 404 permits in the Colorado River and North Platte River Drainage Basins.

For the purposes of this analysis, the Proposed Action and the alternatives assume adherence to these plans, permits, leases and regulations for the protection of water resources. Many potential impacts associated with gas development are common to all alternatives and therefore are analyzed for general impacts in section 4.4.3. As these impacts vary by alternative and can be expanded on they are discussed in relation to each alternative.

4.4.1.1 Surface Water Impacts

Potential impacts that may occur to the surface water system due to the proposed project include increased surface water runoff, wind erosion, and off-site sedimentation due to soil disturbance associated with construction activities (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, and duration of time within which construction activities occur, and the timely implementation and success/failure of mitigation measures. Impacts would likely be greatest shortly after the start of construction activities and would likely decrease in time due to stabilization, reclamation, and revegetation efforts (See appendices B, H, and J). Changes in surface flow patterns from road construction would continue through the life of the project and may extend beyond the project life if these roads are left in place. Petroleum products and other chemicals could be accidentally spilled resulting in surface water contamination. If these spills occur, they would be addressed with the Hazardous Materials Management Plan (appendix C).

4.4.1.2 Groundwater Impacts

The primary effects on groundwater resources would be associated with the removal of groundwater contained in coal aquifers and the subsequent recharge of aquifers through injection of produced water. The removal of groundwater from the coal aquifer results in the reduction of the hydraulic pressure head. The lowering of hydraulic head in an aquifer is also referred to as drawdown. The effects would result in progressive drawdowns within nearby wells completed in the same coal bed aquifers or in other aquifers hydrologically connected to the coalbeds. Impacts may include the interruption of groundwater flow to existing nearby springs, seeps, and flowing artesian wells. Another impact of the proposed project on groundwater resources would be an increase in the hydraulic pressure head in the aquifers receiving the injected coal bed water.

4.4.1.3 Assumptions for Analysis

Under all alternatives, the following would be adhered to: applicant committed measures (described in appendix K), required BMPs (appendix H), and BMPs for Non-Point Source Pollution (appendix J) as applicable, as well as the regulation and plans described in section 4.4.1. As per NEPA guidance, this analysis will be based on the premise that standard operating procedures including these BMPs and regulations will be adhered to under each alternative. The ARPA contains several active gas fields. There are 205 (116 are CBNG) active producing natural gas wells with accompanying production-related facilities, roads, and pipelines (http://wogcc.state.wy.us/). There are also abandoned well sites that in some cases are not fully reclaimed, the number of which is difficult to estimate. While the ARPA environmental analysis was being prepared, 116 CBNG were drilled in six POD locations to determine the feasibility of full-field development.

Approximately 80 percent of the ARPA is within the Colorado River Basin, with 69 percent lying within the Muddy Creek drainage area, 17 percent within the Great Divide Basin, and 3 percent within the Missouri River Basin. Table 3-10 summarizes the data for soil factors of concern and their extent within the ARPA. Table 3-11 shows the five soil categories as they relate to each of the twenty-one, 6th-level HUCs. The HUC boundaries are shown on map M-10.

The no action alternative (Alternative A) would deny the proposed action. The approved pods would continue to be developed and operated (See table 1-1) under the lease terms and conditions of approval attached to APDs, and in the manner and conditions described in each pod's Environmental Assessment (EA) and decision record. Impacts would be similar to those described in the environmental assessments for the pods. New proposals for developing gas leases in the project area would be considered as they are proposed. If impacts are determined to be significant for these proposals, a new EIS process may be initiated.

All action alternatives assume the construction of up to 2,000 wells and associated roads and pipelines based on the drilling schedule shown on figure 2-1. The specific location of these facilities has not been provided by the operator under any alternative.

The Atlantic Rim project area is 270,080 acres in extent. The proposed action is for 8 wells per section or 80-acre spacing. The ARPA divided by 80-acres equals 3,376 potential well sites for the project area. Only 2,000 wells are proposed by the operators and 116 have been developed during the interim drilling period. Future CBNG development could be at a maximum intensity of 80-acre spacing. This means that approximately 37 percent (1 - 2,116/3,376) of the ARPA, 110,800 acres may not experience concentrated development (i.e. 80-acre well spacing). The extent of the unused (or less used) portion of the project area will be defined by the suitability of production of natural gas and may or may not be continuous. These areas without concentrated well locations would potentially experience surface disturbance from roads and pipelines to access wells and could also include areas of less dense conventional well development. The operators have indicated that they will drill at wider spacings when geologic, permeability and other conditions allow, but such areas are unknown at this time. In addition, if drilling and production activities are developed at a wider spacing, more area within the project area could be effected (example: 200 wells at 80 acre spacing effects 1,600 acres while 200 wells at 100 acre spacing effects 2,000 acres).

Specific locations for well sites or areas of concentrated development have not been identified in the proposed action; therefore this analysis will consider impacts throughout the project area. Approximately 166 injection wells are anticipate for the project. Both injection and conventional wells could share pads with CBNG wells (appendix H), although specific locations cannot be predicted. A certain percentage of the conventional well locations will be unsuccessful, and be abandoned and reclaimed; this has been estimated as 35 percent for the Desolation Flats EIS. However, it can be assumed that all the CBNG well locations would be used through the life of the project. This is because CBNG wells that do not produce gas may still be used to remove water from the coalbeds and increase gas production in other wells.

Several regions in the project area may not be developed. For example, the far north pod of (map 3, Pod #1, no name pod) was not developed during the interim drilling period based on results of drilling on private estate. Because there is no information to predict where concentrated development may occur and proposed action does not specify regions that will be more intensively developed, development at 80-acre spacing throughout the project area will be analyzed, except where restricted by BLM alternative(s).

The maximum surface disturbance for the Proposed Action is anticipated to be 15,800 acres or about 6 percent of the project area. With successful reclamation, about 2.3 percent of the project area would be disturbed after reclamation and into the production phase (appendix K, table K-3). Of this disturbance about 66 percent of the development is on federal mineral lands (appendix K, table K-3).

Produced water disposal will primarily occur via an estimated 166 injection wells. Impacts from any potential new disposal methods not currently occurring within the ARPA will be analyzed in separate project-specific NEPA documents to fully analyze potential impacts.

Wetlands/Riparian and Floodplain areas have been identified along intermittent and perennial waters as well as those associated with springs, seeps and/or wells (map M-16) from NWI, USGS Hydrography data, and site visits to evaluate PFC for range management. Most 100 year floodplain areas would occur within 500 ft. of perennial waters or 100 ft. of ephemeral drainages. These features would be identified during onsite investigations and would be avoided for the location of permanent features. As part of standard oil and gas mitigations, areas within 500 ft. (~1/10 mile) of surface waters, identified 100-yr floodplains, and wetlands are managed for controlled surface use, also called avoidance areas (see appendices J and H).

Alternative C would not allow pad sites in some areas of environmental concern and would institute development protection measures (appendix L) that are based on resource concerns identified using spatial data (GIS). Many of these protection measures are specifically designed to reduce impacts to surface and groundwater resources. Under all alternatives, development protection measures would not apply to private or state lands. Alternative D would limit the amount of unreclaimed disturbance area at any given time to no more than 7,600 acres (See section 2.2.4).

Surface Water Assumptions

The analysis for surface water is based on the following specific assumptions:

- Disturbance to soil and vegetation, including compaction of soil, would increase water runoff and downstream sediment loads, and lower soil productivity thereby degrading water quality, channel structure, and overall watershed health in some locations.

- The degree of impact attributed to any one disturbance or series of disturbances is influenced by several factors including location within the watershed, time and degree of disturbance, existing vegetation, and precipitation.

- Increased pollutants in surface waters would degrade habitat used by aquatic life and would affect other uses (e.g., stock-watering, irrigation, and drinking water supplies).

- BLM would continue to develop and maintain water sources in upland area to reduce impacts on wetland/riparian areas, and provide a resource for livestock grazing.

- Access roads would follow standard construction practices. However, properly designed roads would still alter hillslope hydrology and concentrate overland flow increasing erosion in some areas. In areas with steep topography, roads are expected to be longer resulting in greater impacts to surface water resources.

- Fine-textured soils are more susceptible to water erosion and compaction when wet; whereas, coarse-textured soils are more susceptible to wind erosion (See section 4.3).

Groundwater Assumptions

For the purposes of this analysis, the no action alternative for groundwater would only consider the impacts of approved development within the project area. This would include 116 CBNG wells drilled during the Interim Drilling Policy (appendix A). The location of these wells would be in the originally approved POD boundaries and would include one injection well for every 12 CBNG wells (about 10 injection wells).

For the purposes of this analysis, potential locations of CBNG wells were estimated to build the groundwater model. Assumptions were made based on the geology and unit boundaries described by the operator early in the process. The groundwater modeling assumptions are discussed in section 4.4.3.

4.4.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with water resources:

1. To meet or exceed established standards for quality of surface water and groundwater where water quality has been lowered by human-induced causes;

2. To reduce salt loading in watersheds that lie within the Colorado River Basin;

3. To maintain riparian areas in good or excellent condition and to improve riparian areas that are in fair or poor condition;

4. To control flood and sediment damage from natural or human-induced causes; and

5. To provide for physical and legal availability of water for use by the public and by federal, state, and, local agencies for fisheries and wildlife and for livestock, recreational, municipal, and industrial uses.

Significance criteria are developed to gauge the magnitude an impact would have on the human environment. An impact on water resources as a result of project actions would be considered potentially significant if its magnitude was such that special mitigation is warranted or it persists indefinitely.

The significance criteria listed in 40 CFR 1508.27 are not necessarily scientifically or factually determined. For example one significance criterion is “the degree to which the possible effects on the quality of the human environment are likely to be highly controversial.” For this analysis, the approach to establishing significance criteria was based on legal issues (i.e., government regulatory standards), public perception, available scientific and environmental documentation, and professional judgment of resource specialists, as specified in 40 CFR 1508.27.

4.4.2.1 Surface Water Significance Criteria

Impacts to surface water resources would be considered significant if the following were to occur:

1. Degradation of water quality beyond the designated use of the receiving water body, or other violations of federal or state water quality standards or negatively impacting a water body listed on the State 303d list of Impaired or Threatened Waterbodies.

2. Project activities elevate salt loading to the Colorado River system above background conditions.

3. Unmitigated loss of wetlands or wetland function (EO 11990 and 11988).

4. Project-related activities that degrade wetland/riparian areas such that, as a minimum physical state, PFC Standards for Healthy Rangelands (USDI-BLM 1997) are not being maintained.

5. Streamflow characteristics of intermittent drainages or perennial streams are altered such that established uses are affected.

6. Alteration of stream channel geometry or gradient by accelerated runoff and erosion (e.g., undesirable aggradation, degradation, or side cutting) beyond what would be expected by natural processes.

4.4.2.2 Groundwater Significance Criteria

Impacts to groundwater resources or springs caused by project activities would be considered significant if the following were to occur:

1. The natural flow or level of groundwater to existing local springs, seeps, flowing artesian wells or permitted water supply wells is interrupted or reduced, regardless of use or non-use.

2. Groundwater quality in any aquifer is degraded such that it can no longer be classified for its current use(s).

3. Accidental spills of fuels, liquids, chemicals, or hazardous material affects the quality of groundwater.

4.4.3 Direct and Indirect Impacts

4.4.3.1 Direct and Indirect Impacts Common to All Alternatives

There are 2,000 proposed new well pad locations (CBNG and Conventional) under all action alternatives. Under the action alternatives, impacts of individual well pads, roads, pipelines and other infrastructure would have the same individual impacts where mitigation is the same. Under Alternative C additional development protection measures will generally result in reduced effects.

All action alternatives would require the pumping of water from coalbeds in the upper Mesaverde Group from the Almond formation. This would result in lowering the hydrostatic pressure head, creating associated impacts to water resources. These impacts would occur in slightly different locations and at different times depending on the alternative assessed.

Surface Water Impacts Common to All Action Alternatives

The main impacts to surface water resources are the removal of vegetation, increased soil surface exposure, mixing of soil horizons, soil compaction and decreased infiltration capacity, loss of topsoil productivity, and increased susceptibility of the soil to wind and water erosion. Therefore, the primary impact of the proposed project on surface water resources is increased surface runoff, erosion, and off-site sedimentation that would cause channel instability and degradation of surface water quality in some locations.

Martherne (2006) found increased sediment production from well pad locations and confirmed that roads and well pads can provide conditions for focusing runoff and locally increasing erosion. Based on field observations, the author found that roads on sideslopes facilitate the erosional process in three ways: (1) roads cut across and collect runoff from previously established drainages (2) roads, where they are cut into hillsides or into the land surface, provide focal points for the initiation of erosion; and (3) roads also provide conduits for sediment transport. Once mobilized, a portion of this sediment (resulting from these erosional processes) will move into channels in pulses that occur in relation to storm events. Some of this sediment will be temporarily stored in drainage bottoms and on the hillslope and a portion will be stabilized by vegetation and not travel to the drainage. The amount of sediment that will be added to specific drainages can only be estimated based on site-specific information available after annual planning and on-site inspections.

Changes in upland runoff, hydrology, or increased sedimentation could reduce habitat for non-game fish, coldwater fish, and aquatic life, especially in the Muddy Creek Drainage. Habitat for non-game species includes pools and riffles. With increased sediment loads, riffles can become silted in and pools can fill, degrading the habitat. Changes in upland runoff conditions can increase peak flow conditions and may reduce base flows critical for maintaining late season pool habitats.

Waters of the U.S. are managed in section 404 of the CWA and permits from U.S. Army Corps of Engineers (ACOE) may be required for dredge and fill activities. All notification and construction criteria will be adhered to and the ACOE will be consulted when questions about the permit use arise. The Great Divide Basin is unlikely to have any waters of the U.S. because it is internally drained and has no major water based recreation sites. Standard mitigation requiring avoidance of surface waters, riparian areas, and wetlands (See appendix H) will limit surface disturbance in these areas on public land to linear features such as road and pipeline crossings. Activities that modify the morphology of stream channels are also subject to regulation by the State of Wyoming. Permitting for construction activities in these areas would take place during the annual planning process and copies of notices or permits may be required of the operator before construction is approved (See appendix H). The effected environment in special aquatic sites and wetlands are discussed in greater detail in section 3.5.

Surface Hydrology Related to Soils Data and Topography. Soils with the potential for severe water erosion comprise about 96 percent of the ARPA (261,000 acres of slight/severe, moderate/severe, and severe/severe categories, see tables 3-10 and 3-11). Tables 3-10 and 3-11 summarize the data for the following five categories and their individual ranking criteria for the contiguous ARPA: water erosion, wind erosion, runoff potential, topsoil rating, and road rating. Because so much of the ARPA has the potential for severe water erosion, soil disturbance both during construction and during production can be expected to result in hillslope and channel erosion under each action alternative above background conditions. Erosion in areas with sensitive soils can be either catastrophic or simply chronic. Surface disturbance

combined with sensitive soils and highly variable precipitation would result in sudden and deeply incised erosion in the form of rilling and gullying, even in relatively gentle terrain. This would occur under all action alternatives in some locations.

Soil characteristics such as depth, permeability, runoff rate, water capacity, and susceptibility to erosion vary widely. The diversity of soil parameters would require a broad spectrum of reclamation techniques. In addition, low annual precipitation and wind and water erosion could make successful reclamation in the ARPA difficult to attain. Therefore, the overall potential for successfully stabilizing disturbed soils is poor to fair.

Because specific sites have not yet been identified for wells, pipelines, and roads, tables 3-10 and 3-11 indicate a likelihood of encountering soil limitations that would require special attention. For example, large portion of the ARPA would likely experience difficulties during revegetation due to the presence of excess salts in the soil or poor/fair topsoil rating (maps M-9 and M-13).

Reclamation Success and Roads. It is important to note that even successful reclamation (appendix B) does not necessarily return an area to its previous function for surface hydrology. For example, re-establishing 80 percent of pre-disturbance groundcover in five years would be considered successful. Background groundcover amounts can be estimated at 20-65 percent (groundcover would include rocks and litter in addition to vegetation, i.e. total cover). Perennial forbs, brush, and trees generally are more effective at reducing rain splash and can provide structure on the soil surface that can reduce surface runoff energy, but are generally not required for reclamation. Anderson (1975) in a study of 23 watersheds found that conversion of a steep forest and brush lands to a grassland had multiplied sediment yields by five times. Although this is an extreme case, it points out that not all vegetation is the same hydrologically. Where interim reclamation has been successful, sagebrush and other brush regeneration will occur within the project life; however, many areas would not return to pre-disturbance function until 30–50 years after final reclamation.

New access roads would be constructed for the purpose of natural gas field development. There are three types of roads identified for the project. Collector and local roads are to access multiple well pad locations and resource roads are to access individual well pads. As described in the applicant committed measures (appendix K), roads would be designed to BLM Manual 9113 standards to minimize disturbance, and all surface disturbance would be contained within the road right-of-way (ROW). Where drilling is non-productive, disturbed areas, including the well site and new access roads, would be reclaimed to the approximate landform that existed prior to construction. If drilling is productive, 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 that are no longer needed.

Under all alternatives road construction would modify the surface hydrology by intercepting and concentrating surface runoff, and in certain instances (e.g., a road cut into a hillside) intercept and alter groundwater flow. Road surfaces decrease infiltration and concentrate flows. Roads would also contribute sediment to downstream drainages from the road surface and from surface disturbance based on construction and road maintenance activities. Properly designed roads would be more able to shed water in a non-erosive manner and this would reduce impacts compared to roads that are improperly or inadequately designed. However, even with proper design using BLM Manual 9113 standards, there would be local impacts in terms of erosion and changes in hydrology. Where roads are in steep country or road densities are

great, these impacts can be expected to include accelerated erosion and increased runoff and could alter downstream channels.

During drilling and completion operations (according to appendix K, table K-2), roads could be used by about 13 heavy trucks per week for about 2 weeks, and about 5 to 10 small trucks per day. During production, resource roads would be used less often (maybe 1 small truck per day) and would occasionally accommodate heavy trucks for water disposal, reclamation activities, and well maintenance. This means that road design needs to allow for heavy truck traffic and at least one visit per day in all kinds of weather. This amount of road use would likely result in dust production from the road base and would increase wind-born erosion from the project area. Road design and maintenance is therefore critical to reduce impacts from the project.

Site erosion and off-site sedimentation from pad sites would be reduced by re-vegetating unused portions of the pad sites in the first appropriate season (fall or spring) after drilling, and providing surface water drainage controls, such as berms, sediment collection traps, diversion ditches and erosion stops as needed. These measures would be described in individual APDs.

Under all action alternatives, local impacts would include accelerated erosion and increased runoff leading to increased sedimentation and changes in hydrology from surface disturbance for the construction of pad sites, roads, and pipelines. Depending on the alternative considered, these impacts could be significant based on the criteria set forth in section 4.4.2.

Surface Water Quality Impacts from Salinity Offsets. Surface discharge at the Cow Creek Pod can be expected to continue through the life of the project under all alternatives according to the WYPDES permits #WY0042145 and #WY0035858, which allow for 1.34 tons/day of salt and 180,600 gallons/day of total discharge. As an offset for an oil well (as defined by the Colorado River Salinity Control Forum) the permit allows for the same volume of water and salt as was discharged by the plugged oil well (#1X-12).

Discharge is into a reservoir on a tributary to Dry Cow Creek; this reservoir would be improved and maintained according to this use. The discharge permit has been modified to allow for water releases from the reservoir in a similar manner as what occurred historically when #1X-12 was in operation; however, volume restrictions would still be in place. The permit would have a new point of compliance upstream of the confluence with Cow Creek. This point of compliance would be monitored for flow, and according to the permit it should only have water during storm events, that is, in response to natural precipitation and not a result of project discharges because Dry Cow Creek is ephemeral.

The Colorado River Salinity Forum established by the 1974 Colorado River Basin Salinity Control Act (Public Law 93-320) regulates the amount of salt load that can enter the Colorado drainage basin. Current loads approved by the state exceed the 1-ton-per-day limit because of the offset value of plugging #1X-12. Allowing for offsets with volume restrictions limited to historical levels with flowing wells is not expected to have any significant impacts, because project-related discharges would be almost identical to current conditions.

Groundwater Impacts Common to All Alternatives

The primary effects on groundwater resources would be associated with the removal of groundwater contained in coal bed aquifers and the subsequent recharge of aquifers through injection of produced water. The removal of groundwater from the coal aquifer results in the reduction of the hydraulic pressure head. The lowering of hydraulic pressure head or water

levels in an aquifer is also referred to as drawdown. The effects of producing water from the Almond Coal Beds would result in progressive drawdowns within nearby wells completed in the same coal bed aquifers or the interruption of groundwater flow to existing nearby springs, seeps, and flowing artesian wells receiving groundwater from the same coal aquifer. Another impact of the proposed project on groundwater resources would be an increase in the hydraulic pressure head in the aquifers receiving the injected coal bed water.

A predicted total project volume of produced water in the best success scenario for the CBNG development would be 250,000 to 450,000 barrels of water per day (bwpd) for approximately six to eight years. However, it should be noted that these volumes are estimates. With the need to remove waters from sands adjacent to the targeted coalbeds, which appear to be in hydrologic connection (See section 3.4.5), these volumes could be higher. Produced water from this project would be disposed of through 166 injection wells completed in the Hatfield, Cherokee or Deep Creek sands in the Haystack Mountains Formation within the Lower Mesaverde Group and underlying the Allen Ridge Formation. Assuming the lowest estimate for injection well efficiency (5,000 bwpd), 166 injection wells should handle 830,000 bwpd (nearly two times the highest estimate of water disposal). The water would be injected into these wells for the life of the project. No cumulative impacts to the target members of the Lower Mesaverde Group would likely occur as a result of this project. If injection capacity is insufficient or water disposal needs are significantly greater than anticipated, additional injection wells or injection wells in other formations may need to be developed.

Groundwater could also be affected during drilling operations. If they were to occur, improper casing and cementing of wells, undetected spills, or leachate from produced water or mud pits could introduce contaminants into the groundwater. Chemicals used for production drilling could cause local contamination of soils and groundwater if not managed properly. Construction of drilling pads, proper disposal practices, proper well casing and cementing, and recycling of drilling fluids would be in accordance with BLM guidelines and should minimize effects on groundwater quality. If accidental spills occur, they would be addressed through implementation of the Hazardous Materials Management and Release Contingency Plans (appendix C) and Spill Prevention Control and Countermeasures (SPCC) plans developed in accordance with 40 CFR Part 112 (appendix K) for the Atlantic Rim project.

Drinking water sources near the ARPA include a groundwater well field for the town of Rawlins in the upper portion of the Sage Creek watershed, the Little Snake River for the towns of Baggs, Dixon, Savery and Slater, and shallow domestic groundwater wells for rural ranch houses. The loss of hydraulic head in aquifers feeding groundwater sources for domestic wells along the eastern boundary of the project area is the most likely potential impact to these resources; however no domestic water wells are listed in the SEO database along the eastern boundary of the project area. None of the known drinking water sources for municipalities are likely to be impacted from the project. Rawlins city wells located to the east of the Mesaverde Group outcrop and are likely completed in formations below the Steel Shale (a significant aquatard) which underlies the Mesaverde Group. Because only 3 percent of the ARPA is in the Savery drainage upstream of Baggs, Dixon, Savery, and Slater, it is unlikely that the project will impact the quality or quantity of water available for these towns.

Appropriate measures would be taken during project development to prevent impacts on existing groundwater quality during dewatering. Given the present state and federal regulations regarding general water quality, as well as salinity in the Colorado River Basin, surface discharge of produced water is not anticipated. Water would be used during construction,

drilling activities, and dust abatement subject to state permits. Most of this water would come from the CBNG wells; however, some may come from sources that could impact surface resources. Therefore, water to be used for construction and dust abatement was estimated and depletions consulted on with the US FWS in regard to the Upper Colorado Endangered Fish Recovery Program. Water produced from coalbeds is assumed to be unconnected to surface water based on isotopic analysis, groundwater modeling and water quality characteristics.

Accidental surface discharge could impact nearby surface water quality by increasing salinity levels. The extent of any impact would depend on the quality and quantity of the produced water and any fluids being released and would be addressed with the implementation of the Hazardous Materials Management and Release Contingency Plans (appendix C).

Water Disposal Using Injection. Produced water would be disposed of in underground injection wells, except in the case of the Cow Creek Pod that has a surface discharge WYPDES permit. The conditions of this permit allow for the same volume of salt and water to be discharged as would have occurred had not well #1X-12 been plugged. Produced water would also be used for drilling, construction, dust abatement, and other project-related water uses subject to approval from the State of Wyoming for this use. Water could also be used in closed-system stockwatering tanks. None of these uses would be for water disposal needs; primary water disposal would be through injection wells.

Underground disposal of produced water would be accomplished using an estimated 166 deep injection wells (appendix K). Depth of the injection wells is expected to range from 3,200 to 6,400 feet (e.g., Hatfield, Cherokee, or Deep Creek sands within the Haystack Mountain Formation). All injection wells would have permits prepared and submitted to the WOGCC. The only effect on the injection formations would consist of an increase in the hydraulic head emanating from the injection well, which would dissipate with distance away from the well bore.

Produced water would be collected in buried polyethylene pipelines for transport to an injection well. Centrifugal pumps, reciprocating pumps, filter systems, and tanks at the disposal facility would be used to remove solids from the water stream and to pump the water at pressures sufficient to allow downhole disposal. 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.

Each deep injection well would have an approximate minimum injection capacity of 5,000 barrels per day (bbls/day) and a maximum injection capacity of 15,000 bbls/day. A predicted volume of produced water in the best success scenario from the CBNG wells would be 250,000 to 450,000 bbls/day for approximately 6 to 8 years. The volume of water would consistently decline as the coalbeds are dewatered.

The deep injection wells would be drilled, cased, and cemented from total depth (approximately 50 feet below the base of the Hatfield, Cherokee, or Deep Creek sands) to the surface. These sandstone formations are isolated above by the Lewis Shale and below by the Baxter or Steel Shale, which are thick, competent marine shales that are effective barriers to groundwater flow. The deep sandstones would be tested to evaluate suitability for disposal before any water is injected. Maximum pressure requirements to prevent initiation and propagation of fractures through overlying strata to any zones of fresh water have also been determined and would be

regulated by the State of Wyoming and the BLM. The results of the open-hole log and injectivity test would be provided to the regulatory agencies. The injectivity tests would be used to determine the fracture pressure limits that would be imposed to ensure the overlying and underlying shale is not breached. The fracture gradient of the shale aquitards that overlie and underlie the injection horizons would not be exceeded based on injectivity tests and applicable permit limits. Thus, all injected water would be contained in the injection formations and would not migrate vertically.

Groundwater Quality. Well drilling and completion activities are not likely to impact existing groundwater quality if the project is in compliance with On-Shore Oil and Gas Order No. 2. These guidelines specify the following:

> …proposed casing and cementing programs shall be conducted as approved to protect or isolate all usable water zones, potentially productive zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use.

However, poor drilling and completion techniques could result in degradation of groundwater quality 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 degradation of groundwater quality in any aquifers is low.

Usable water is defined as groundwater with a TDS of 10,000 parts per million or less encountered at any depth. To comply with the order, wells must be completed such that either usable water is isolated from unusable water, or that unusable water is isolated from usable water through the use of cementing and other proven technologies. Assuming compliance with this order, no contamination of usable groundwater would likely occur. Well drilling and completion as proposed in chapter 2 appears to comply with the Onshore Order No. 2.

Injection of the CBNG-produced water is not expected to result in any deterioration in groundwater quality within the injection formations. The proposed injection formations have been water quality tested to evaluate suitability for disposal, and the results show that groundwater to be of lower quality (higher TDS) than the produced water from the coalbeds of the Almond Formation. Sandstone strata of the injection formations are isolated above and below by competent shale barriers that would likely prevent the infiltration of the injected water into any overlying fresh water zones. BMPs would be implemented to ensure surface spills of produced water do not occur. All water disposal plans would be permitted with the state agency that regulates the facilities, including but not limited to the WOGCC and WDEQ–WQD.

Springs and Seeps. The ARPA contains numerous springs and seeps which are important local water sources for livestock and wildlife. At least 70 active springs are contained within the ARPA. Prolonged drought in southern Wyoming has reduced the number of seeps, especially in the Sand Hills portion of the project area, but these groundwater resources are expected to recover with cessation of drought conditions.

Springs in the ARPA occur primarily at the contact between the Upper Cretaceous Mesaverde Group and the overlying Tertiary-age deposits of the Browns Park Formation. Springs also

occur within the outcrop area of the upper Mesaverde Group itself and at its western contact with the Lewis Shale.

Tertiary deposits in the ARPA near the surface are recharged by direct downward percolation of precipitation and snowmelt. Deep aquifers in the ARPA are recharged by these processes in outcrop and subcrop areas and from slow leakage from overlying and underlying aquifers. The extent of the Tertiary units (Browns Park and North Park Formations) that lie atop the eroded, dipping Cretaceous units indicates a probable recharge of the underlying Mesaverde Group. Should groundwater withdrawals from upper Mesaverde Group coalbeds in the ARPA result in water-level declines that propagate updip to their subcrop areas beneath the overlying Tertiary units, the Proposed Action could affect some of the Cretaceous/Tertiary contact seeps and springs. However, the predicted groundwater drawdown analysis for this project does not indicate groundwater level declines would extend updip to the coal seam subcrop areas. Therefore, it is unlikely that the proposed project would have a dewatering effect on the overlying Tertiary deposits, which would diminish flows from the contact springs and seeps.

Methane seeps could possibly develop in the outcrop region of the Mesaverde Group as a result of this project. These seeps could contaminate shallow groundwater sources and may also cause the death of vegetation in limited areas. The number or location of these seeps is impossible to predict, therefore monitoring would be established to evaluate this impact (See section 4.4.5). These seeps have been documented with CBNG development in the San Juan Basin along with other areas of CBNG development. In the San Juan Basin many of these seeps, even before production, occurred in the outcrop regions of the producing formations.

Groundwater monitoring wells indicate that the reduction of pressure or hydrostatic head within the upper Mesaverde Group will not be isolated to the coalbeds, but will likely extend to Mesaverde sandstones. Artesian conditions in the upper Mesaverde Group may be responsible for the surface expression of springs and seeps located along the Mesaverde and Lewis Shale contact, along faults, or within the Mesaverde Group itself. Impacts may include the loss or reduction of flow in these systems, and would depend on individual spring dynamics. Eventually the upper Mesaverde will recharge with precipitation and pressures will recover. Effected springs and seeps could take 50 years or more to recover. The Lower Mesaverde Group, (Haystack Formation) is the location of the injection zones and therefore could be impacted by increased pressure. Communication of these zones will dictate the feasibility of injection and will be determined by Wyoming injection well permitting.

As described in section 3.4.2.1 although there are numerous perennial springs that occur in the headwaters of Muddy Creek, these springs are not likely adding to the baseflow of Muddy Creek, due to evapotranspiration and conveyance losses. This is evident by the intermittent nature of flows in Muddy Creek. The discharge that makes it to the Little Snake River is primarily from snowmelt or individual precipitation events. Therefore even with loss of flow in springs and seeps, the reduction of pressures in the upper Mesaverde Group is unlikely to result in depletions to the Muddy Creek system.

Flowing Wells. There are at least 16 flowing wells in the project area have been developed to supply water to wetland areas and/or stock watering facilities and may be impacted by reducing flow volumes or changing water quality characteristics. The chemistry of water sampled from at least one of the flowing wells in the ARPA (Duck Flow 2 well, see table 3-29) indicates that the groundwater may be from the Almond Formation coalbeds. Many of these flowing wells are abandoned exploratory oil or gas wells drilled in the 1950s or 60s, that had some portion of the

casing fail adjacent to strata under artesian pressure. It is likely that some of these flowing wells have casing failures adjacent to Almond Formation coalbeds (many of the flowing wells produce methane gas along with water, methane is commonly associated with coalbeds). The Almond Formation coalbeds are targeted by this project for production and therefore these flowing wells may be impacted by reduced flow volumes. The groundwater model predicts a 3–30 percent decrease in flowing well volumes by 2050, with full recovery in the year 3000 (WWC 2006). Individual wells may respond very differently depending on the depth and extent of the casing leak or leaks for individual wells.

Water Rights Related to Groundwater. As discussed in chapter 3, the SEO records identify at least 90 active permitted, non-CBNG-associated groundwater rights in the ARPA. Of the 90 permitted wells and springs, 58 reported positive yields, many of these are developed within the Mesaverde Group and/or are associated with the Browns Park Formation. There are also productive wells developed in the Lewis Shale that may be the result of flows from the Mesaverde Group. Groundwater currently in use in the project area that is obtained from Tertiary-age units (i.e. contact springs from sources in the Browns Park Formation) should not be affected by groundwater level declines in the Mesaverde Group coalbeds. However, permitted water rights in the project area that obtain water from the Cretaceous-age coalbeds or other formations in the Mesaverde Group that are dewatered by the proposed project would likely be affected by the resulting groundwater level declines.

A numerical groundwater flow model was used to predict drawdown impacts to the groundwater system under the Proposed Action. Modeling was warranted because of the large extent of, variability in, and cumulative stresses imposed by development of CBNG on the coal bed aquifers of the upper Mesaverde Group. The assumptions used to support the predicted groundwater drawdown analysis, the computer model used in the analysis, and the predicted drawdown impacts for this project are described in detail in the Atlantic Rim EIS Ground-Water Modeling Technical Support Document (WWC 2006).

Regional Groundwater Model Description and Findings

A numerical groundwater flow model was used to predict drawdown impacts to the groundwater system under the Proposed Action. Modeling was necessary because of the large extent of, variability in, and cumulative stresses imposed by development of CBNG on the coal bed aquifers of the upper Mesaverde Group. The assumptions used to support the predicted groundwater drawdown analysis, the computer model used in the analysis, and the predicted drawdown impacts for this project are described in detail in the Atlantic Rim EIS Ground-Water Modeling Technical Support Document (WWC 2006).

The modeling consisted of three separate tasks: calibration and verification, simulation and sensitivity analysis. After a steady state model was calibrated with the goal of matching a know potentiometric surface with modeled results. CBNG wells were then added to the model and calibrated with know pumping rates of CBNG wells. A sensitivity analysis was performed on five modeling parameters: drain conductance, global hydraulic conductivity, hydraulic conductivity within layers 2 and 4, recharge rates, and storage coefficients (WWC 2006).

The regional groundwater flow model for the ARPA is based on the geology and hydrogeology described in chapter 3. The groundwater model encompasses the western flank of the Sierra Madre and extends into the Washakie Basin roughly 30 miles west of the ARPA. This model cannot be used to predict results at a localized scale and any attempts to do so would require

additional data and additional modeling efforts. The Atlantic Rim Groundwater Model Technical Report (WWC 2006) includes a detailed discussion on calibration of the groundwater flow model. The hydrogeologic model code selected was the USGS Three Dimensional Finite Difference Modular Groundwater Flow Model, (MODFLOW) (MacDonald and Harbaugh 1988) and the pre/post processor, Groundwater Vistas (Rumbaugh and Rumbaugh 2002).

Hydrogeologic Groups in the ARPA

Within the ARPA, the Mesaverde Group strata dip westward off the Sierra Madre uplift at about 22 degrees. The thickness of the Mesaverde Group ranges from 2,000 to 3,000 ft. The Mesaverde Group consists of four members, which in ascending order are the Haystack Mountains Formation, the Allen Ridge Formation, The Pine Ridge Formation, and the Almond Formation. The uppermost member, the Almond Formation, contains numerous carbonaceous shale intervals and coalbeds. The lateral continuity of these coal units is considered sufficient such that they act as a regional aquifer system. Although individual coalbeds may split and merge, there is sufficient hydraulic communication, on a regional scale, to allow movement of groundwater.

The coal-bearing Almond Formation ranges in thickness from 400 to 600 ft and occurs at depths of less than 100 ft in the center of the ARPA to about 1,800 ft below ground level along the western boundary. The Lewis Shale, which overlies the Almond Formation, reaches a thickness of 2,700 ft in the Washakie Basin and is consistently more than 2,000 ft thick in the ARPA except where it has been removed by erosion. The Lewis Shale is a low permeability unit considered to be a regional confining layer. Unconformably overlying the Cretaceous sediments is the Tertiary-age Browns Park Formation. Contact springs are relatively common at the base of the Browns Park Formation where it is in contact with the less permeable units of the Mesaverde Group. Due to the lack of contact between the Almond Formation and the Browns Park Formation, groundwater within the Browns Park could not be impacted by groundwater withdrawals from the Almond; therefore, the Browns Park Formation was not included in the model.

Assumptions for Groundwater

For the purpose of the modeling study, the primary unit of interest is the coal-bearing Almond Formation and Pine Ridge Formation of the Mesaverde Group. Specifically, the coalbeds within the Almond Formation and the sands in the Pine Ridge Formation are the aquifers of interest. Overlying the Almond Formation is the Lewis Shale, a regional confining layer. Underlying the Almond Formation is the Pine Ridge Formation and beneath the Pine Ridge is the Allen Ridge Formation, which is also considered a confining unit. The Almond Formation and the underlying Pine Ridge Formation are primarily recharged from natural precipitation infiltration along their outcrop on the western flank of the Sierra Madre. The natural groundwater flow direction is generally westward, down dip toward the basin center. Groundwater within the Almond coals is unconfined near outcrop recharge areas, but rapidly becomes confined away from the outcrop. For modeling purposes, the overlying Lewis Shale and underlying Allen Ridge Formation are sufficiently impermeable to prevent leakage into or out of the Almond and Pine Ridge Formations. Infiltration of surface water that occurs in the small ephemeral and intermittent streams in the area can effectively be ignored in the model, as the streams are predominately located within the overlying Lewis Shale. Therefore, little if any recharge can be expected anywhere other than the outcrop area.

A number of flowing wells potentially completed within the Almond Formation are located throughout the ARPA. Potentiometric data, albeit sparse, was compiled for the Almond coals in

the ARPA and eastern Washakie Basin. A potentiometric surface map of the Almond Formation under current conditions is included in the Atlantic Rim groundwater model Technical Report (WWC 2006). Hydraulic gradients are steeper near the outcrop and become less steep into the basin. In addition to the potentiometry data, drill stem test data and age-dating Almond coal groundwater indicate that groundwater velocities under natural gradient are extremely low.

The primary physical groundwater flow boundary is the Mesaverde Group outcrop to the east. Near the center of the Washakie Basin, which would be along the western portion of the model domain, evidence suggests that there is little, if any, groundwater flow in the westward direction. Within the model, the western boundary is represented by a no flow boundary. The north and south boundaries are not marked by any natural geologic features, but are located far enough from the proposed production wells in the ARPA that their influence on the wells would be minimal. For this reason, the north and south edges of the model are artificial boundaries.

There is very little measured hydraulic conductivity data available for any of the five modeled layers within the ARPA. The hydraulic conductivities assigned to each layer were based on information that is presented in the Atlantic Rim groundwater model Technical Report (WWC 2006). To account for anisotropic conditions in the vertical direction, the vertical hydraulic conductivity would be 10 times less than the horizontal conductivity. Within the model, the hydraulic conductivity of the sand layers would vary based on the average hydraulic conductivity at burial depth. Like the sands within the Almond Formation, burial depth is assumed to affect hydraulic conductivity for the coals, with a lower value for the deeper coals and a higher value for the shallower coals. Coals would have slightly smaller hydraulic conductivity values than the sand units, but values would be varied with depth similar to the way hydraulic conductivity values for the sand units were varied. At this time, there is very little reliable storativity or specific yield data for the modeled layers; therefore, values were based on USGS estimates, which are based on the estimated thickness of the aquifers (WWC 2006).

The groundwater model necessarily simplifies the geology that is apparent in the Upper Mesaverde Group. For example, there are three monitoring wells in the ARPA that were established during the interim drilling period and will be maintained through the life of the project. These monitoring wells measure pressure in the producing coalbeds and sand stone aquifers directly above and below the coalbeds. Groundwater monitoring data appears to confirm that the coalbeds and sand layers in the upper Mesaverde Group are hydrologically connected. Locally, the hydraulic connection between the coal layers and sand layers could potentially be enhanced if the integrity of the confining layer is compromised (e.g., by poorly plugged exploratory drill holes). Leakage from the sands into the coal production layer appears to be occurring as water levels in the coalbeds are lowered as a result of dewatering. It is likely that many of the coalbeds are in juxtaposition with overlying and/or underlying sandstones, because much of this area is faulted. This means that the coalbeds within the upper Mesaverde Group are not isolated from sands in the Upper Mesaverde Group. There is hydrologic connection predicted between layers 1, 3 and 5; therefore the model construction allows for this complexity to some degree, but can not model the spatial variability in transmissivity between layers that most likely exists.

Model Construction

The hydrogeologic model code selected was the USGS Three Dimensional Finite Difference Modular Groundwater Flow Model, MODFLOW (MacDonald and Harbaugh 1988) and the pre/post processor, Groundwater Vistas (Rumbaugh and Rumbaugh 2002). MODFLOW is a

model code widely used and accepted by regulatory agencies and the BLM. Seven MODFLOW packages were used in the Atlantic Rim groundwater model (WWC 2006).

The model grid is oriented parallel to the geologic strike of the Almond Formation outcrop, which is generally north-south. The model area encompasses some 2,866 square miles. The regional model consists of five layers. The top layer represents the Almond Formation sandstones, the second layer represents the clay and siltstone parting below the Almond sandstones, the third layer represents the production coalbeds within the Almond and Pine Ridge Formations, the fourth layer represents the clay and shale partings below the coalbeds, and the fifth layer represents the Pine Ridge Formation. As mentioned above, the monitoring wells indicate that there may be more hydraulic communication than represented by the model, between the producing formations and the upper Almond and Pine Ridge sandstones, modeled by layers 1 and 5. The Lewis Shale acts as a confining layer above the Almond Formation and the Steel Shale acts as a confining layer below the Pine Ridge Formation. The model area is bounded on the east by the outcrop of the Almond Formation, on the west by a no-flow boundary, and due to the lack of natural geologic boundaries, prescribed constant head cells bound the north and south portions of the model domain.

The hydraulic parameters within the groundwater model area include hydraulic conductivity, storage, and recharge. Hydraulic conductivity is largely unknown in the model area and values assigned within the model were based largely on information obtained from testing conducted in oil and gas fields outside of the model area by the oil and gas industry, limited testing on coals within the ARPA, and testing of coals within the Powder River Basin in Wyoming. Based on borehole logs within the ARPA, the bulk of the Almond Formation and Pine Ridge Formation is generally composed of sand, with the coals, siltstones, and shales making up a small portion of the formations. Within the model, the hydraulic conductivity of the sand layers would vary based on the burial depth (i.e., values decrease with depth). The hydraulic conductivity values assigned to the shales and siltstones were much lower than that of the sands and coals. Storage coefficients within the model were estimated based on the modeled thickness of each layer. Due to instabilities in the model based on the steep (22 degree) dip of the Mesaverde group, some of the modeled thicknesses do not correspond to actual thicknesses of formations. This decision is unlikely to impact the results of the model. To account for anisotropic conditions in the vertical direction, the vertical hydraulic conductivity was estimated to be 10 times less than the horizontal conductivity ($K_y = K_x = 10K_z$).

The principle source of recharge is natural precipitation infiltration at the Mesaverde Group outcrop on the western flank of the Sierra Madre. Within the model, recharge would occur within the upper portion of the Mesaverde Group containing the Almond Formation and Pine Ridge Formation and the total recharge would be 3–9 percent of the average annual precipitation.

Groundwater flow into the Washakie Basin is very sluggish, if it even occurs at all. Based on this assumption, it follows that there are no natural drains within the interior portion of the basin. The only natural drains to the system occur near the contact between the upper Mesaverde Group and the overlying Lewis Shale as springs. These contact springs were simulated in the model as drains inserted into the top layer. The only other drains within the model area are flowing wells completed in the Almond Formation. The flowing wells are discharging from the same coalbeds that are proposed to be produced; therefore, they were inserted into layer 3. The locations and elevations of the springs and flowing wells were determined from U.S.

Geological Survey mapping and Wyoming SEO records. Spring discharge rates were also determined from SEO records or assumed to be similar to that of nearby measured spring flows.

Limitations of the Model

Many of the assumptions and limitations within the modeling software are the result of the inaccuracies inherent in modeling a natural system and are generally similar for all modeling software. Limitations and assumptions specific to this modeling effort are primarily due to the paucity of physical and hydraulic characteristics of the aquifers and confining units in the regional model area, as described in detail in the Atlantic Rim groundwater model Technical Report (WWC 2006).

Simulation of the Projected Effects

The simulation portion of the model replicates the proposed development within the ARPA. Presently, the most severe development scenario projects that a maximum of 1,800 CBNG wells would be completed within the ARPA. Current production predictions estimate that the wells would produce water for 20 to 30 years, so the average life of water production for each well was 25 years and each drain simulating a well was left active for 25 years within the model. The development scenario assumes that wells within the interior portion of each unit would be developed first, with wells expanding concentrically from the center of the unit out to the edges of the ARPA boundary. After a drain was turned on, it was left on for 25 years. The modeled simulation period extends in 5-year increments from 2005 to 2050, with the last production well being turned off in 2050. Drawdown contours from the projections within the five modeled layers at the end of each 5-year period are shown in figures included in the Atlantic Rim Groundwater Model Technical Report (WWC 2006).

The results of the simulation show that the drawdowns within the coalbeds (layer 3) are large as compared to the drawdowns projected within the overlying and underlying sands (layers 1 and 5, respectively). The maximum drawdown and areal extent of drawdown within the Almond Formation coal (layer 3) is projected to occur in 2030. Drawdown contours projected to occur for layers 3 (coal package), 1 (overlying sandstone package), and 5 (underlying sandstone package), respectively, in year 2030 are depicted on maps M-35, M-36, and M-37. As shown, maximum cumulative drawdowns in the coal are greatest at the production well locations, although drawdowns do not propagate down dip to the west. In fact, no drawdowns in the produced coal are expected to occur beyond the western boundary of the ARPA. Coal drawdowns are projected to propagate somewhat more in the updip direction toward the Almond Formation's outcrop, although would not actually reach the outcrop. Based on the monitoring well data these impacts to layers 1 and 5 may be more significant then predicted by the model.

While the drawdowns within the coalbeds are large close to the producing wells, the water discharge rate decline for each well is not as rapid as expected. Table 4-6 presents the average per well discharge rate at the end of each 5-year period between 2010 and 2050. Table 4-7 depicts the modeled impacts to the various existing flowing wells within the ARPA, and as shown, impacts to the flowing wells are predicted to be minimal. Impacts to the contact springs are also predicted to be minimal. In year 2005, the modeled spring discharge was approximately 88,800 cubic feet per day for the entire model area. In year 2050, the modeled spring discharge was approximately 85,700 cubic feet per day for the entire model area.

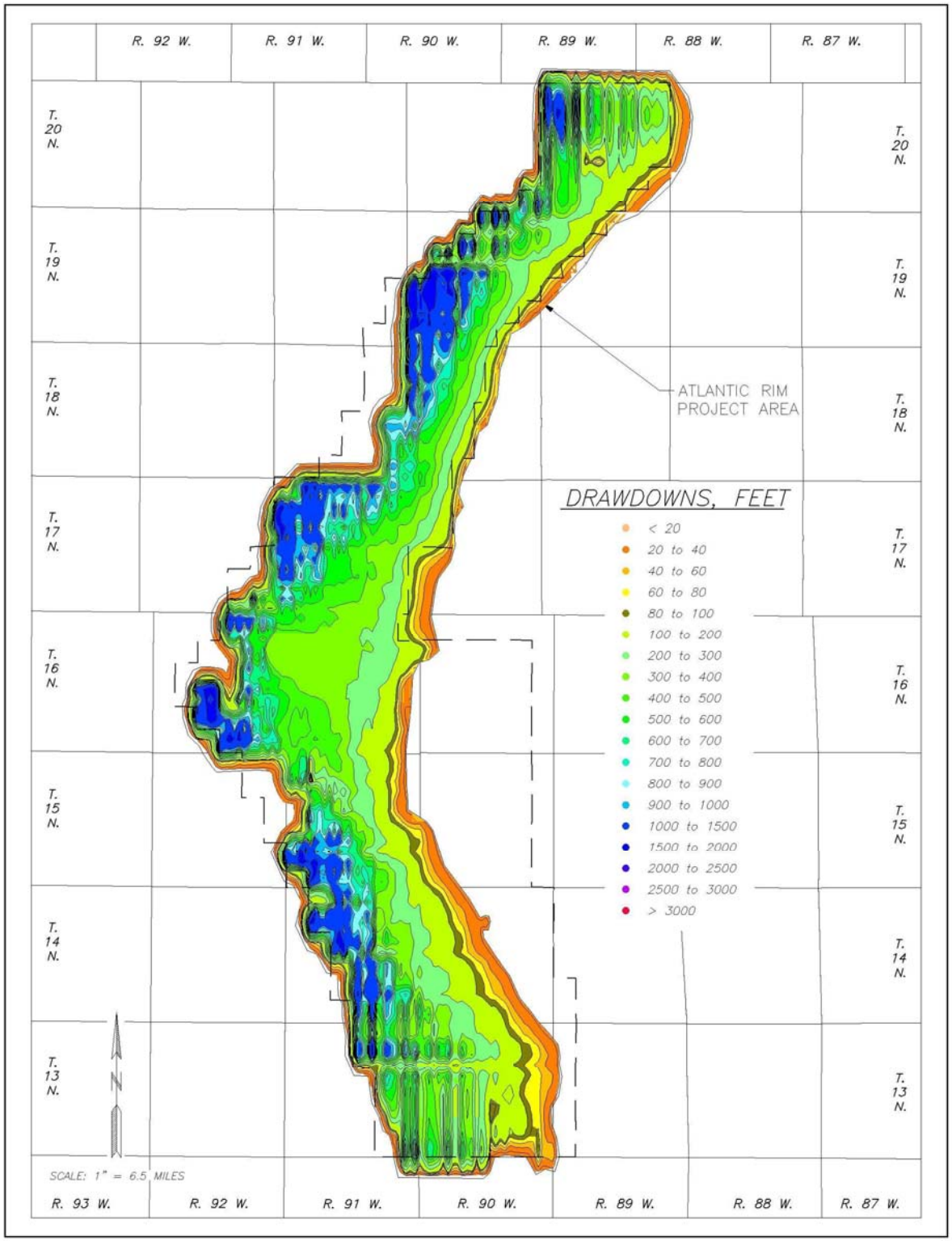
Table 4-6. Average per Well Discharge Rates in Five-Year Increments during the Simulation Period.

Year	Number of Wells in Production	Average Discharge Per Well (gpm)
2005	48	30.1
2010	989	32.4
2015	1368	34.2
2020	1651	33.7
2025	1720	32.9
2030	1682	32.9
2035	904	34.4
2040	422	33
2045	105	22.9
2050	8	7.8

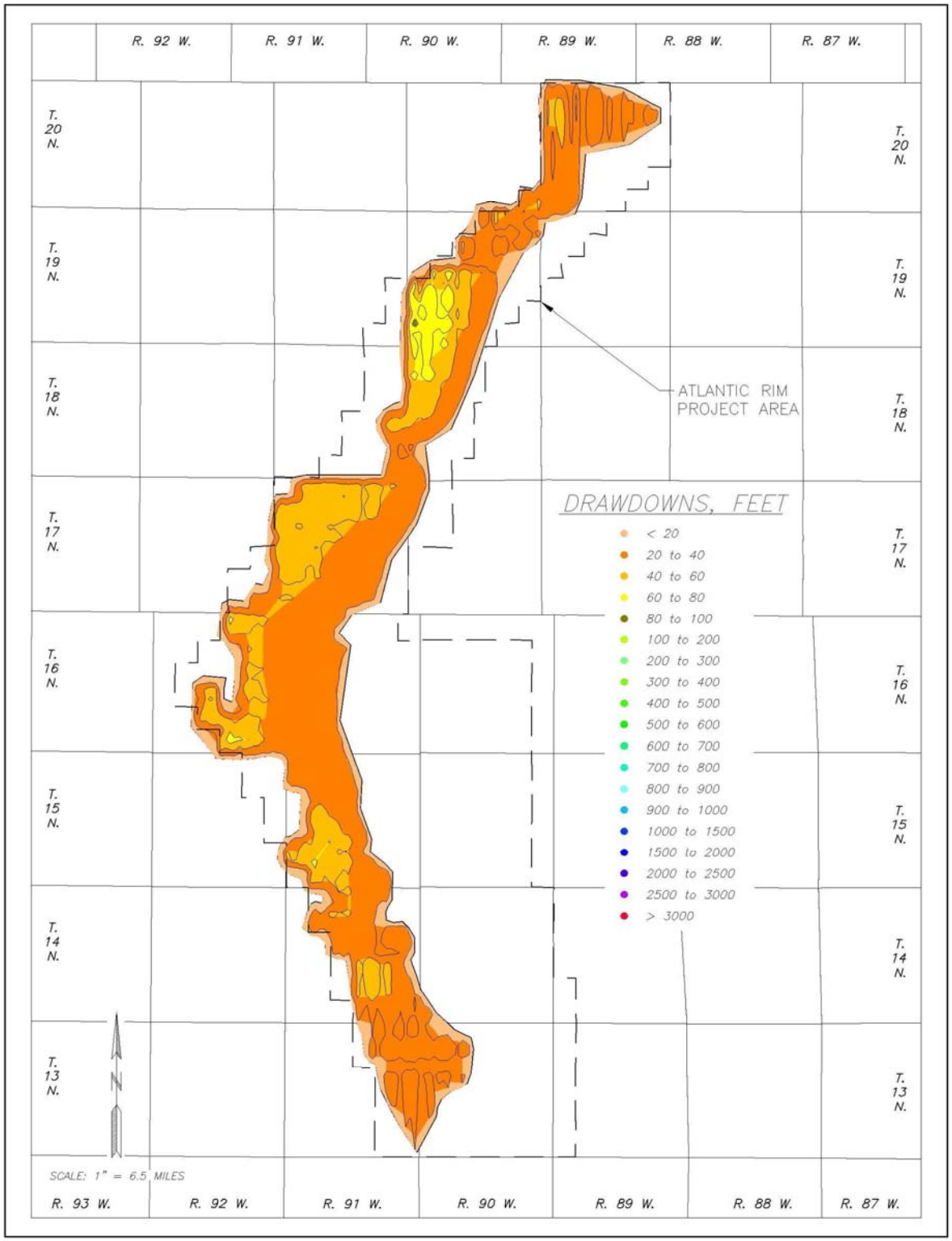
Table 4-7. Impacts to Flowing Wells in Year 2050.

Latitude	Longitude	Row	Column	Year 2000 Modeled Flow Rate (gpm)	Year 2050 Modeled Flow Rate (gpm)
41.0894	107.4968	114	190	30	27.9
41.0725	107.5053	115	188	28	26
41.0887	107.4782	114	195	2	1.4
41.1985	107.5103	95	186	15	12.9
41.2613	107.5798	84	167	2	1.6
41.6022	107.4658	22	199	3	2.2
41.2263	107.5572	90	173	21	20.4
41.1946	107.5880	96	165	5	3.5
41.1902	107.5675	97	171	5	4.0
41.3024	107.6040	76	161	21	19
41.3240	107.6160	73	157	9	8
41.3493	107.6245	68	155	24	21.4
41.3495	107.5956	68	163	8	7.2
41.3815	107.5660	62	171	9	8.6

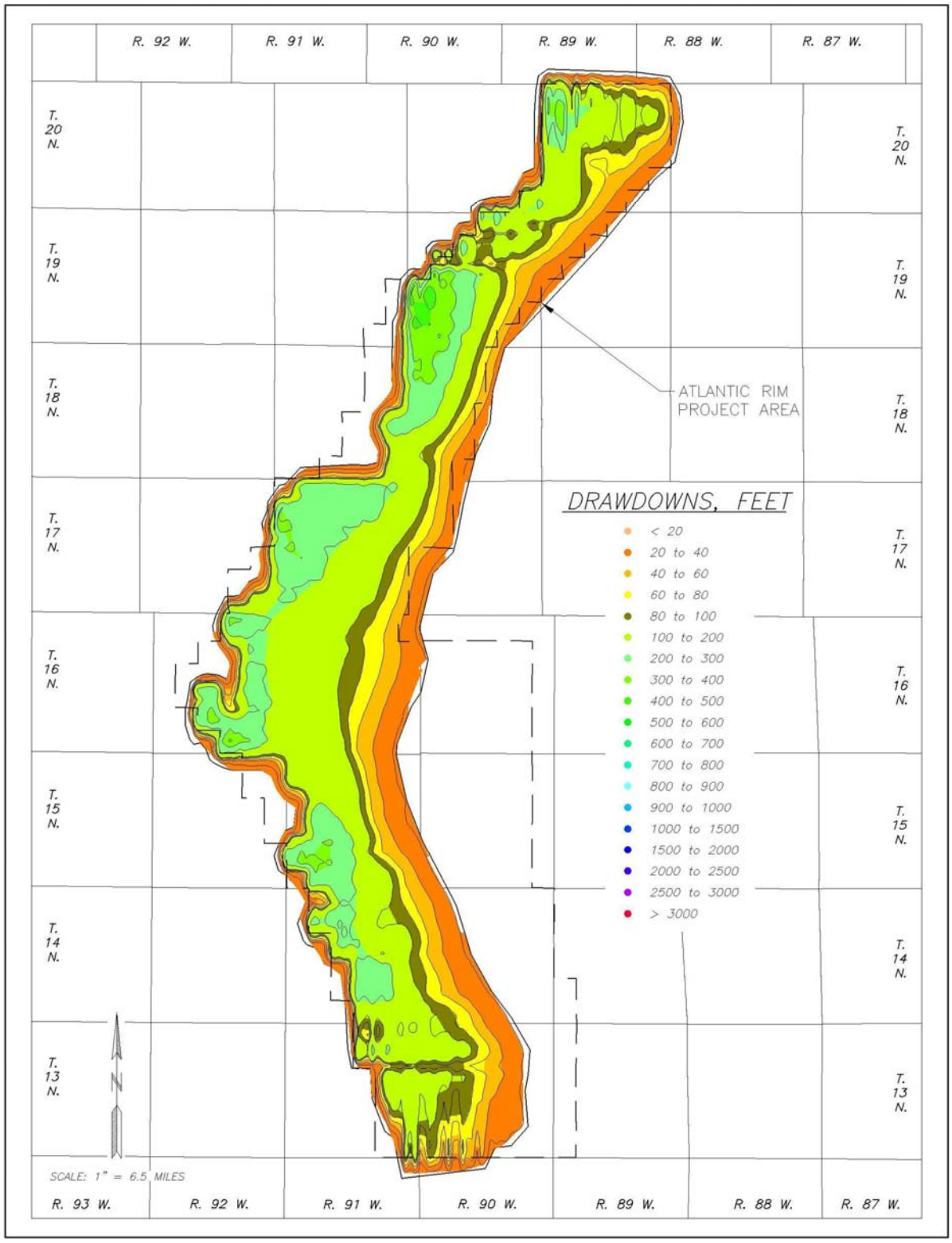
Map M-35. Drawdowns within Layer 3 for Year 2030.



Map M-36. Drawdowns within Layer 1 for Year 2030.



Map M-37. Drawdowns within Layer 5 for Year 2030.



After water production starts to decline, recovery of water levels in the coals will begin. Based on the projected schedule of field development, all production is expected to end by 2050. In order to simulate recovery, all drains except for the ones simulating the contact springs were shut off by 2050. The model was then run for an additional 950 years to model the long-term effects of groundwater withdrawals. Recovery predictions for years 2100, 2500, and 3000 are included in the Atlantic Rim Groundwater Model Technical Report (WWC 2006). The model predicts that recovery in the coal would be slow; however, most of the recovery would have occurred by the year 3000.

The model also predicts that it takes a relatively long time for groundwater adjustments within the coal to have an effect on groundwater levels within the Almond Formation sands and Pine Ridge Formation. The timing of the maximum impacts to the Almond/Lewis Shale contact springs demonstrates this phenomenon. The most severe impacts to the springs were modeled in the year 3000, at which time the discharge rates start to increase. This recovery scenario assumes a constant recharge based on the recharge rates arrived at empirically during the steady-state calibration. This recharge rate, while arguably the best assumption that can be made, is nevertheless based on limited calibration experience and research information available at this time.

4.4.3.2 Proposed Action Impacts

Proposed Action Impacts to Surface Waters

Under the Proposed Action, total construction phase surface disturbance would be 15,800 acres (approximately 6 percent of the ARPA). 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. Combined with the estimated existing disturbance of 600 acres, cumulative disturbance would be about 16,400 acres. Impacts to surface water are not directly related to surface disturbance. As described in section 4.4.3.1, roads and pads can impact surface hydrology beyond their initial disturbance. With successful reclamation during the life of the project (30–50 years), total disturbances would be reduced to about 6,200 acres (about 2.3 percent of the ARPA). As describe earlier most of the ARPA would be difficult to reclaim. Reclamation success is defined in the Reclamation Plan (appendix B). Where sagebrush, juniper or other vegetation was disturbed, the location would not return to pre-disturbance hydrologic function until 30–50 years after the end of the project in some locations as described in section 4.4.3.1.

The construction disturbance associated with the Proposed Action can also be distributed by watershed. As discussed in chapter 3, the entire ARPA is contained within three major drainage basins. One leg of the Continental Divide runs east and west across the upper portion of the project area. Drainage south of this divide flows south and west to the Little Snake River (HUC 14050003) in the Colorado River Basin. A second leg runs north and divides the northwest and northeast portions of the project area. Drainage west of this divide flows north to Separation Lake in the closed Great Divide Basin (HUC 14040200). Drainage east of the divide flows northeast to the North Platte River (HUC 10180002) in the Missouri River basin. The major drainage basins are depicted on map M-14. The Little Snake River flows east to west just south of the ARPA. Approximately 69 percent of the ARPA drains into the Little Snake River via Muddy Creek. Muddy Creek (HUC 14050004) originates in the Sierra Madre Range, east of the ARPA, and flows west and south to its confluence with the Little Snake River near Baggs. The primary Muddy Creek tributaries in the ARPA include, from upstream to downstream, McKinney Creek, Dry Cow Creek, Cow Creek, Wild Cow Creek, Cherokee Creek, and Deep Creek.

Increasing sediment delivery to watersheds above the 303d section of Muddy Creek (section 3.4) would lead to habitat degradation in pools and riffles for fish in these waters, resulting in significant effects. The primary watershed contributing to this segment is the Muddy Creek/Alamosa Gulch watershed (map M-10). The Proposed Action with eight wells per section in this watershed would lead to increases in surface runoff and sedimentation into this watershed and would result in significant impacts.

According to chapter 3.3, there are many topsoils that are saline or sodic in the ARPA. When eroded as a result of project activities, these soils can make salt available to surface waters. This would contribute to the non-point source of salt in the Colorado River Basin and can be expected to be a significant impact to this system because these rates would likely be above background conditions.

Many of the drainage channels in the ARPA may be classified as Waters of the United States. Crossings of these channels and any associated wetlands may require authorization from the ACOE through the CWA Section 404 permitting process. None of the drainages in the Great Divide Basin are likely to be considered Waters of the United States. Because, road and pipeline construction across established channels could modify flow hydraulics, required BMPs would protect these channels from long-term changes in hydrologic function (appendix H). Channel crossing design (as outlined in the BMPs) will minimize changes to channel morphology and flow hydraulics and have suitable capacity to handle a minimum of a 25-year flood event. Guidance for designing crossings is given in appendix J; these would be required for drainages with the potential to support fish populations.

As described in appendix K, water would be required in most aspects of project construction including road construction, drill site construction, well drilling, and pipeline testing. Water for use in the project construction could be as high as 1,000 gallons per acre of disturbance, which would equate to a total of approximately 54 acre-feet of water. Water used in the well-drilling process could be as high as 125,400 gallons, or about 0.4 acre-feet of water per well, for a total of approximately 693 acre-feet (for 1,800 wells). Water used in the deeper, conventional well-drilling process averages 462,000 gallons (1.4 acre-feet) per well for a total of approximately 280 acre-feet (for 200 wells). The operators intend to use freshwater-based mud for the majority of their drilling operations. Water would also be used for hydrostatic testing of pipelines. Assuming one set of pipelines per well pad (single or multiple wells), and all pipelines associated with 2,000 well pads (7,920,000 feet of pipeline) would be hydrostatically tested at once and therefore water would not be reused, approximately 64 acre-feet of water (at 2.6 gallons/feet) would be required for hydrostatic testing of pipelines. Therefore, total water demand with hydrostatic testing for the Proposed Action would be approximately 1,100 acre-feet. This total quantity of water would not be used at one time; rather, this amount would be distributed over the construction phase that could extend over several years as discussed in appendix K.

Water used for construction and drilling may not come from CBNG wells, and therefore could possibly come from sources connected to surface waters in the Colorado River Basin. This volume of water is conservatively estimated as 10.3 acre-feet/year for the life of the project. The potential depletions were part of the consultation process with the USFWS and have been considered in regard with native fish recovery programs in the Colorado River Basin (section 4.8 and appendix G).

Water would be obtained from SEO-approved local surface water sources or water wells completed in the coalbeds of the Mesaverde Group. As described in chapter 3, there are presently 90 active permitted groundwater rights filed in the project area, one of which is for a water well that supplies water for drilling deep oil and gas wells. Historically, water wells have been the primary source of supply for oil and gas drilling in this arid area; it is likely that water wells would supply the proposed project drilling needs. The total water demand identified above would not likely affect the existing surface water or groundwater rights in the project area administered by the Wyoming SEO.

Reclamation would occur on the barrow ditches for roads, portions of well pads, and pipeline ROWs, as described in appendix B. Even after successful reclamation these areas would form distinct vegetation boundaries that may or may not be better for reducing rain-splash erosion or decreasing surface runoff. They also may experience unauthorized travel from off-road vehicles leading to further erosional problems.

Discharge and use of hydrostatic test water would need to be accomplished in a manner that does not affect soils, stream channels, 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 to be used in conjunction with drilling operations or reused for other aspects of the construction and production process. However, if such water is not reused, it must be disposed of in a manner where soil scouring and water quality impairment would not result. Hydrostatic test water is expected to be of relatively good quality; however, it should be evaluated for compliance with state water quality standards. No test water should be discharged unless such water meets these standards. Test water not needed for drilling operations that meets water quality standards would be disposed of onto undisturbed land having vegetative cover or into an established drainage channel in a manner as not to cause accelerated erosion. Further, use and disposal of hydrostatic test water must comply with the mandatory ROW stipulation for hydrostatic testing as well as the POD, the CWA and the WYPDES permit that would be required for the proposed project.

Proposed Action Impacts to Groundwater

The proposed CBNG development in the ARPA is targeted principally at coalbeds in the Almond Formation member of the late Cretaceous Mesaverde Group. Drilling depths for the Mesaverde coals would range from approximately 1,200 to 6,000 feet. Groundwater would be removed from the coal bed aquifers. There is no current practical use for water in these coalbeds due to the high TDS concentrations, and the availability of higher quality water from other aquifers. The targeted coal bed aquifers that would be dewatered are classified as confined to semi-confined aquifers because they are bound by confining sedimentary layers of shale, siltstone, and claystone that are impervious to semi-pervious.

Effects from the development of CBNG to groundwater resources within and near the ARPA have also been evaluated in the South Baggs Area Natural Gas Development Project EIS (USDI-BLM 2000b), the Rawlins Draft RMP DEIS (USDI-BLM 2004c), and the following environmental assessments: Sun Dog Pod (USDI-BLM 2001b), Blue Sky Pod (USDI-BLM 2002b), Cow Creek Pod (USDI-BLM 2002c), Brown Cow Pod (USDI-BLM 2003d), Doty Mountain Pod (USDI-BLM 2003e), Red Rim Pod (USDI-BLM 2003f), Jolly Roger Pod (USDI-BLM 2004b).

Reserve pits would be used to contain drilling fluids, cuttings, and wastewater produced from the well drilling operations. In some cases, the reserve pits would be lined with an impermeable

liner to prevent seepage and possible contamination of surface and groundwater. Leakage of pit fluids would be minimal from lined reserve pits unless the liners were installed incorrectly or the liners were damaged during drilling operations.

4.4.3.3 Alternative A (No Action)

Under Alternative A, the impacts would not be significant because the Proposed Action or other action alternatives would not be implemented. For both ground and surface waters, impacts would continue as described in the environmental assessments developed for each pod during the interim drilling period. It can be expected that, as interim reclamation success improves, impacts to surface water resources would decrease. Final reclamation would disturb areas again initially, but long-term reclamation would reduce impacts to background levels within 30–50 years after final reclamation.

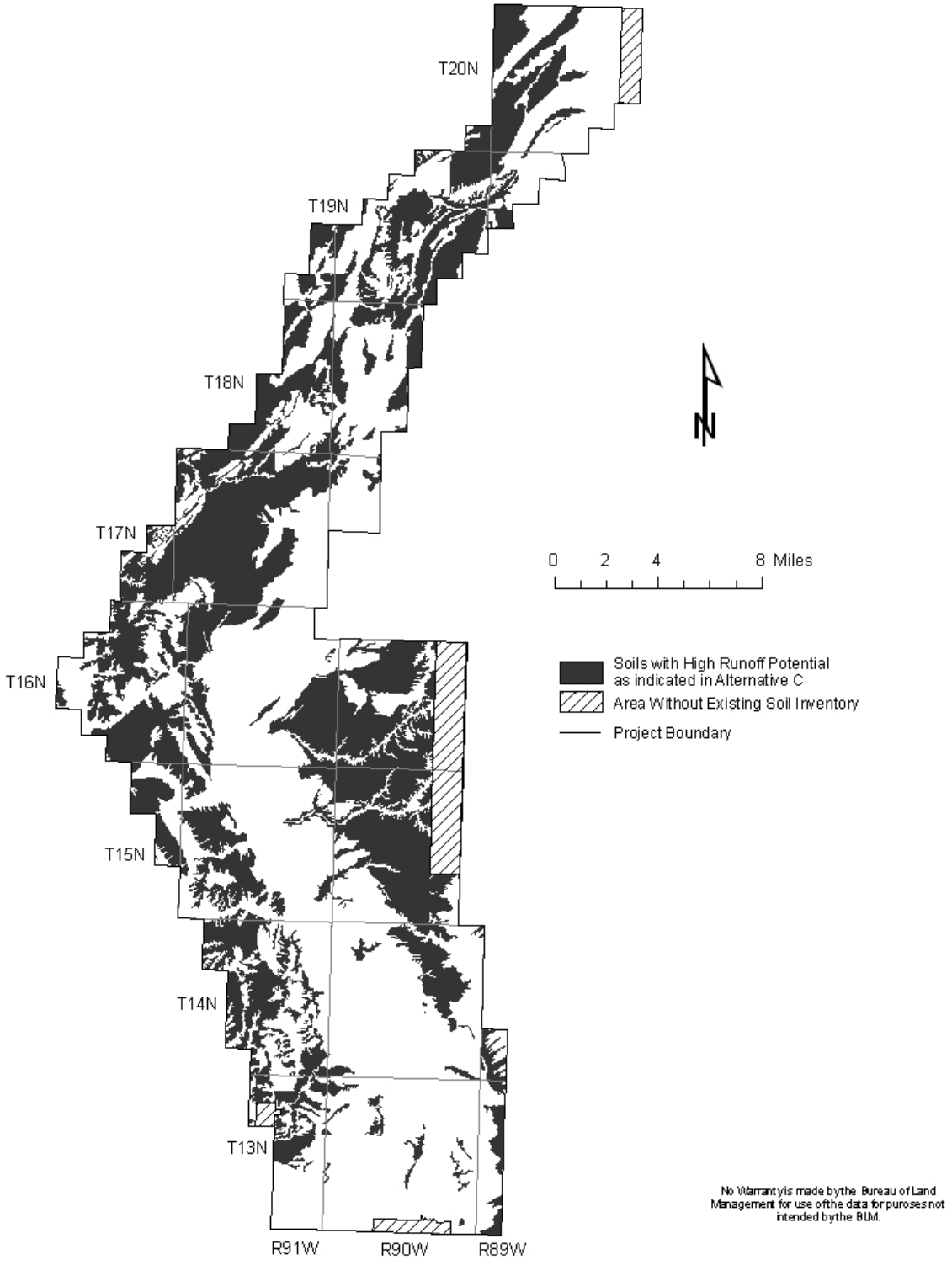
4.4.3.4 Alternative C

Under Alternative C the impacts to surface waters are not expected to be significant due to the implementation of development protection measures in addition to standard mitigation measures. These protection measures would only apply to Federal Mineral development, but with 64.3 percent of the project area Federal Lands and 66 percent Federal Minerals, these protection measures would apply to the majority of the project area.

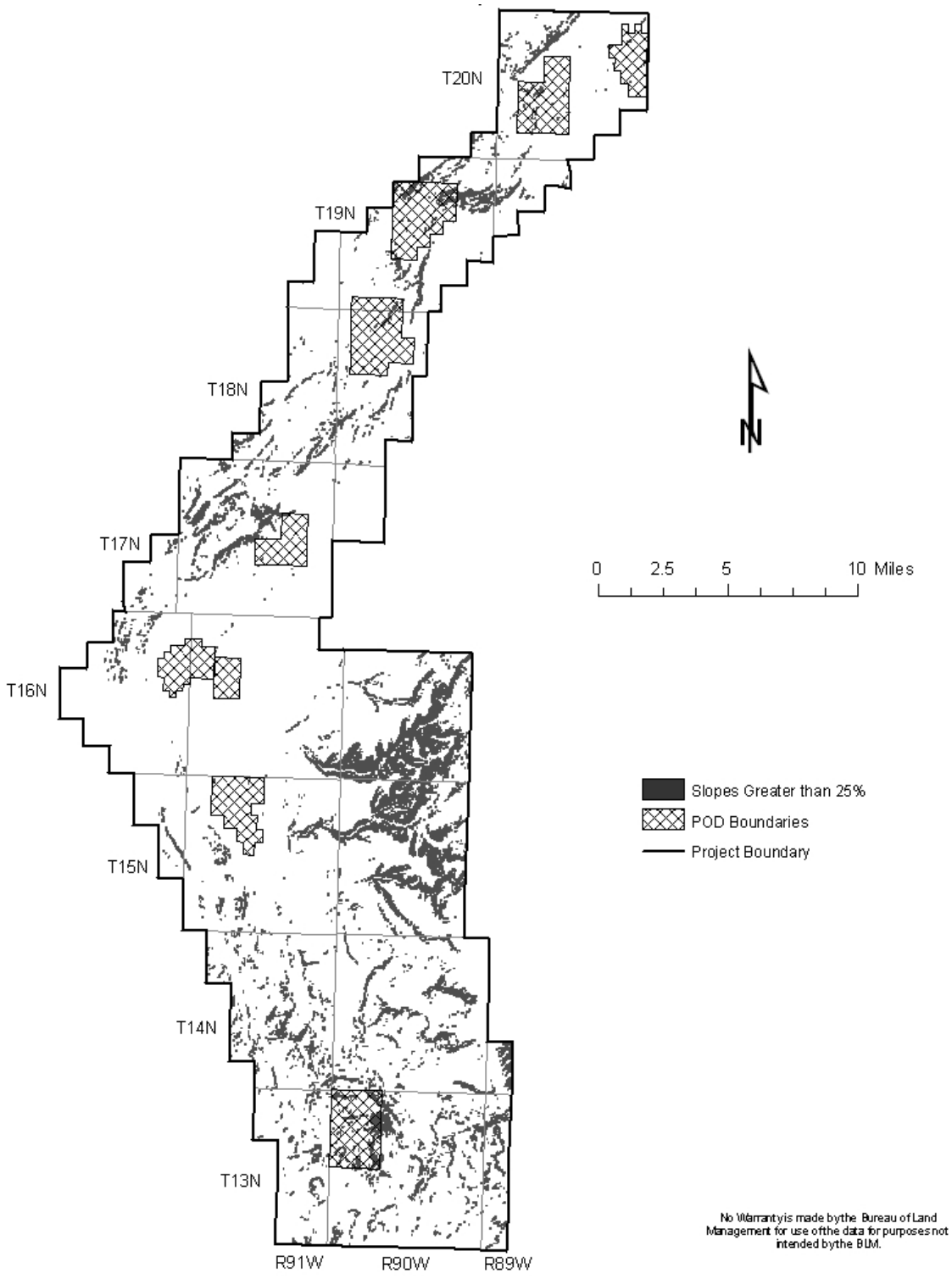
The locations where these protections would apply also have unique conditions, such as poor soils or steep slopes, which may be responsible for a greater degree of impacts to water resources from surface disturbance, and thus would benefit more from having protection measures applied. For example, the blocked federal land in Townships 15N 90W and 16N 90W (map M-3) have soils with high runoff potential (map M-38) and a high percentage of steep slopes (map M-39). Under Alternative C, these areas would only be developed with four well sites and 20 acres of disturbance per section. In addition to fewer well sites and reduced disturbance in these sensitive areas, other protection measures in Alternative C would be applied, such as closing the reserve pit, reclaiming the first year after drilling, and low impact road design, among others. The combination of these protection measures in areas that benefit the most from their application would decrease impacts by reducing changes in peak flows from surface runoff and intercepted groundwater, result in less erosion and smaller increases in sediment loads, provide for improved reclamation success, and generally reduce impacts to water resources.

Mitigation in the Muddy Creek/Grizzly SMA would limit road densities to 3 miles/mi^2, would limit road construction and pad location on slopes greater than 8 percent and would require comprehensive planning that could remove the likely impacts to the 303d listed segment of Muddy Creek downstream from the project area. Current road densities in these areas are less than 2 miles/mi^2 (See section 3.4.4.2), but could increase to more than 3 miles/mi^2 under some development scenarios. Thus, these protection measures are likely to protect the 303d listed reach of Muddy Creek from habitat degradation resulting from this alternative.

Map M-38. Soils with High Runoff Potential.



Map M-39. Alternative C–Slopes Greater than 25%.



In general, development protection measures proposed for Alternative C would have the effect of limiting surface disturbance in the areas of most concern for impacts to surface waters. Only 4 wells per section and less than 20 acres of disturbance would be allowed in the majority of public lands (see map M-38). As described in table 3-10, soils with a high runoff potential make up 41 percent of the project area. Wildlife restrictions would also limit the density of pads and the short-term disturbance on the majority of federal lands. In mixed land ownership areas, more disturbance could potentially occur on state and private lands (See table 2-1). However, with the better placement of facilities, protections measures, and fewer disturbances approved on public lands, this alternative would likely reduce impacts.

Road and pad placement at 4 wells per section as opposed to 8 wells per section provides more flexibility in the placement of pads and roads, and therefore reduces impacts. This ability to optimally place facilities within sections reduces impacts on the federal lands and for the project as a whole.

Surface water impacts for Alternative C are not likely to be significant due to the lower density of development, optimal placement of project facilities, and the mitigation required for resource areas that are of concern for impacts to water resources.

There should not be a significant difference between this alternative and the Proposed Action for groundwater resources.

4.4.3.5 Alternative D

Potential impacts for Alternative D would be similar to those described under the Proposed Action, but would be less due to a limit on the total unreclaimed disturbance for the project (7,600 acres). Less initial disturbance and incentives for better reclamation would allow for fewer impacts to water resources due to the maintenance of undisturbed vegetation, which is generally better to reduce rain splash erosion and reduce surface runoff.

The limitation on surface disturbance as part of Alternative D allows for the same number of pad locations as the Proposed Action and assumes successful reclamation, which is also assumed under the Proposed Action. According to the Reclamation Plan (appendix B), successful reclamation can be measured after initial efforts and require erosion features to be the same as surrounding undisturbed areas. As described in the surface water impacts common to all alternatives, disturbed areas that are converted from shrubland to grasslands may not respond the same hydrologically to storm events and roads, pads, and other long-term disturbances and will still modify the surface hydrology. The annual planning and reporting criteria assumed under this alternative could result in better reclamation efforts, due to better monitoring, tracking, and enforcement.

Potential impacts to surface water for Alternative D would likely be greater than those for Alternative C due to the lack of disturbance limits on federal lands (no more than 4 wells or 20 acres per section) under Alternative D. Development under Alternative D would occur at a density of 8 wells per section including areas with unique conditions, such as poor soils and steep slopes, which may contribute to a greater degree to surface water impacts from land disturbing activities. With the increased development density for wells and roads relative to Alternative C, Alternative D would be expected to result in a greater impact to surface water despite the limitation on unreclaimed surface disturbance.

Disturbance to Category A (map M-7, 72,200 acres or 27 percent of the ARPA) areas for this alternative would be reduced to below 6.5 acres per well. Because Muddy Creek SMA is near the center of the project area, it likely will be developed as described in the Proposed Action with the Cow Creek and Sand Hills SMAs receiving relatively less development. As stated in the assumptions much of what determines impacts for surface waters is the location of the disturbance. Due to development at a density of 8 wells per section within the Muddy Creek SMA significant impacts would be anticipated to the Muddy Creek reach below Highway 789, which is listed for 303d threats (See section 3.4 and map M-17).

Impacts under Alternative D are lower than under the Proposed Action (18 percent less surface disturbance), but indirect impacts would still be significant to water resources due to potential water quality changes, rainfall runoff relationships, increased salt loading from disturbed areas, and changes in surface hydrology from long-term disturbance.

4.4.4 Impacts Summary for all Action Alternatives

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 to wind and water erosion. These impacts could increase runoff, erosion, and off-site sedimentation. in Wyoming's 2006 305(b) Water Quality Assessment Report WDEQ states, "… projected increases in CBNG development have the potential to lead to increased surface disturbance and possible increased erosion and sediment loading" (WDEQ 2006).

Groundwater impacts are expected to be significant due to the likely impacts to wells, seeps and springs emanating from the upper Mesaverde Group. Many of these wells are permitted by the SEO and the springs and seeps may have flows interrupted.

4.4.5 Additional Mitigation Measures

The Required BMPs (appendix H) would be followed on BLM lands or where a BLM approved action would impact BLM lands. A modification to a mitigation measure or design feature may be approved on a case-by-case basis when deemed appropriate by the BLM.

Applicant committed measures would be applied on privately owned surface and State of Wyoming lands unless otherwise specified by the involved private or state surface owners. The operators and the BLM, as discussed in chapter 2 and appendix K, would implement preconstruction planning and design activities.

Water quality in Muddy Creek will be measured at USGS Station #09258980 as funding allows. Currently, conductivity and flow are measured continuously and there are joint efforts with the State of Wyoming to measure water quality parameters into the future.

Impacts to groundwater resources have been identified and determined to be significant. The resources of primary concerns are wells completed in the Lewis Shale or upper Mesaverde Group and spring or seeps near the contact between the Lewis Shale and Mesaverde Group. Isotopic data would be collected project wide by the BLM to evaluate groundwater resources and additional monitoring wells in the upper Mesaverde Group would be established to evaluate and quantify impacts to these resources and to quantify potential impacts from methane seeps where the Mesaverde Group outcrops.

A Local Meteoric Water Line (LMWL) would be established based on BLM collected isotopic water samples from surface sources to test assumptions in section 3.4.5.2 about the recharge characteristics of water in coal beds targeted for production base on isotopic analysis of samples from the producing formations.

The BLM would evaluate water levels from a few selected wells to establish baseline conditions in aquifers of interest and to measure potential impacts from the project.

4.5 Vegetation and Wetlands

4.5.1 Introduction

Direct impacts to existing native shrub/grassland communities in the ARPA resulting from project implementation include a short-term reduction of herbaceous vegetation and a long-term loss of shrub cover. Potential indirect impacts to the vegetation resource may occur as a result of:

- Damage to biological soil crusts,
- Soil compaction,
- Mixing of soil horizons,
- Loss of topsoil productivity,
- Increased soil surface exposure,
- Soil loss due to wind and water erosion,
- Increased potential for noxious/invasive weed invasion and establishment,
- Shifts in use patterns or amounts by livestock and wildlife, and
- Changes in visual aesthetics.

4.5.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with vegetation and wetland resources:

- To provide habitat quality (food, cover, space, and water) adequate (1) to support a natural diversity of wildlife and fisheries including big game; upland game; waterfowl; non-game species; game fish; sensitive, threatened, and endangered species; and species of special management interest in Wyoming, and (2) to assist in meeting goals of recovery plans.

- To maintain or improve vegetation condition or avoid long-term disturbance in high priority standard habitat sites and fisheries areas.

- To maintain or improve overall ecological quality, thus providing good wildlife habitat, within the constraints of multiple-use management in moderate and low priority standard habitat sites.

Several criteria were used to determine the significance of impacts caused by the construction and operation of the proposed natural gas project on vegetation resources encompassed within the ARPA. These criteria were developed based on federal, state, and local agency rules, regulations, and management guidelines.

The impact on vegetation would be considered significant if the following were to occur:

1. Non-attainment of short- or long-term reclamation standards and goals for disturbed sites specified by the Reclamation Plan (appendix B) or the BLM resulting in a loss/decrease of plant species density, diversity, and abundance, or where reclaimed areas do not attain adequate vegetation groundcover and species composition to stabilize the site within 5 years from disturbance;

2. An event or action that would remove a community's unique attributes or ability to support other resource values within the life of the project; and

3. Introduction or spread of noxious or invasive weeds that contributes to unsuccessful revegetation, the introduction of weeds into areas considered weed free, or an increase in noxious or invasive species where they already exist.

4.5.3 Direct and Indirect Impacts

4.5.3.1 Direct and Indirect Impacts Common to All Alternatives

Direct impacts include the removal of native vegetation and topsoil during the construction phase and installation of permanent structures (e.g., compressor sites, roads, and well pads). Future climatic patterns, land use, and compliance with the Reclamation Plan and weed control efforts would be primary factors for successful life-of-project reclamation. Established monitoring sites for documenting long-term trends of vegetation cover types would be avoided so that disturbance from permitted commercial activities would not occur.

Potential indirect impacts to the vegetation resource might occur as a result of:

- Soil compaction,
- Mixing of soil horizons,
- Loss of topsoil productivity,
- Increased soil surface exposure causing increased soil loss due to wind and water erosion, and
- Increased potential for noxious/invasive plant establishment.

Additional indirect impacts occur as a result of altered runoff hydrology due to roads, pads, and other facilities particularly on moderate to steep slopes. Slopes greater than 8 percent require special engineering and are found on 35 percent of the project area. Facilities located in these areas reduce natural runoff to downslope locations and increase channelization of flows and gullying, which results in desertification effects including lower productivity, cover, and species composition. Furthermore, dust from roads contributes to an additional indirect impact by settling on nearby vegetation resulting in reduced photosynthetic activity and plant growth. Indirect impacts due to dust from roads would be expected to affect vegetation adjacent to roads, resulting in an additional 15 to 30 percent of the development area (based on estimate of 300 feet width impacted along roads average distance impacted based on professional

judgment). However, application of BMPs in road construction and dust control would minimize this impact (appendix K, section K.1.3.7.2, specifically, Climate and Air Quality).

All alternatives would disturb Wyoming big sagebrush and alkali sagebrush plant communities. Due to the very long to unknown recovery rates for these two shrub species on dry, harsh sites, reclamation would primarily result in herbaceous plant recovery, replacing shrublands with grassland-type cover and structure.

The saltbush steppe vegetation cover type would have very low acreage affected by the proposed project. Badlands have sparse vegetation, occur on moderate to steep slopes, and are common in other areas. Therefore, impacts from disturbance to these vegetation cover types would not affect their overall abundance, health, or diversity across the region.

Thirty-one percent of the aspen, juniper woodland, serviceberry, and true mountain mahogany cover types occur on private and state lands and these sites would not be protected from disturbance by any development. Loss of these communities would increase wildlife use on remaining areas within these cover types. Development in these communities would be avoided on public lands. However, impacts from disturbance to this vegetation cover type may affect its overall abundance, health, and diversity within the region, exceeding the significance criteria.

The silver sagebrush/bitterbrush vegetation cover type occupies sand dunes in what is known as the Sand Hills. The uniqueness of this vegetation/soils complex within the entire State of Wyoming led to the designation of the Sand Hills as an ACEC. The actual ACEC is mostly excluded from the ARPA, but the north end of this unique plant community is in the checkerboard land pattern (map M-3) and a portion is included in the ARPA. The sand dunes, whether stabilized or not, are usually avoided due to the difficulties they pose for development and reclamation. The potential to increase wind erosion and destabilize the loose sand is very high. Therefore, impacts from disturbance to this vegetation cover type may affect its overall abundance, health, and diversity within the region, exceeding the significance criteria.

Due to the scarcity of riparian/wetlands in the ARPA and the existence of BMPs/COAs to protect them, the probability of well pads, roads, pipelines, and ancillary facilities being placed in these areas is very low. The RMP specifies that a 500-foot (minimum) buffer around riparian and other water resources and a 100-foot buffer from ephemeral drainages be maintained on public lands. This restriction not only protects riparian/wetland sites, but basin big sagebrush sites which are generally found adjacent to drainages. Protection of these sites on private and state lands may not occur, which could lead to alteration of vegetation adjacent to stream channels. The probability of removing wetland vegetation or disturbing any waters of the U.S. is low following compliance with mitigation procedures (see appendices B, H, and J). Existing water sources that dry up or have reduced flows due to water drawdown associated with gas field development would be mitigated to maintain wetlands/riparian site characteristics and vegetation, if it can be proved that development of coal bed methane is the cause. However, if pre-data does not exist for individual water sources or if it cannot be proved that drought is not the cause, these water sources would not be mitigated and wetland/riparian sites and vegetation would become drier and potentially convert to upland vegetation.

Although most natural gas would be collected as water is removed from the coal aquifers, some gases may move upslope through the formation and escape through the soil surface. Where this occurs the vegetation may die back, resulting in dominance of herbaceous species and

increased bare ground. These locations would generally be small and scattered along the outcrops of the coal formations, probably affecting less than 10 acres altogether.

Vegetation treatments would become more complex and costly as the density of field development increases. The opportunities to use prescribed burns as a management tool would become more limited, requiring increased use of chemical and mechanical forms of manipulation. These methods decrease the ratio of shrub versus herbaceous species, but primarily influence species already present compared to fire which creates openings for early succession species (especially forbs). Therefore, in areas where the objective is to increase forb composition and there are currently few forb species present in the community, it would be difficult and more expensive to reach this objective using chemical or mechanical forms of treatment.

Direct and indirect impacts to the vegetation resource would be reduced with implementation of and compliance with required best management practices stated in appendix H, applicant voluntarily committed measures (appendix K), the Reclamation Plan (appendix B), and the RMP. However, no measures currently address spreading concentrated runoff back over the land. Therefore, channelization and gullying leading to desertification would occur. Achieving final reclamation goals is dependant upon disturbed soil properties; developing seed sources for native forbs and shrubs; short- and long-term monitoring; future climatic conditions and land-use patterns; and, most importantly, operator commitment. However, the current lack of seed sources for desirable native forbs in the 7- to 9-inch precipitation zone makes any timeline questionable in terms of achieving successful reclamation with desired native species composition. In addition, non-native species, if used in reclamation on state and private lands could expand onto adjacent public lands, requiring some form of both monitoring and control.

The lack of adequate weed control efforts in the first few years of development under the Atlantic Rim pod EAs have already increased weeds and seed banks that would have to be controlled for several years at a minimum. Halogeton has been observed spreading outside areas of disturbance from CBNG development on all land ownerships. There are no applicant voluntarily committed measures to control weeds; therefore, the current trend of weed spread is likely to continue. These populations would continue to pose a threat of expansion onto public lands that would require long-term treatments.

4.5.3.2 Proposed Action

The Proposed Action would directly reduce the extent of existing vegetation cover types. Half of the overall, life-of-project disturbance from the Proposed Action would occur within the first 5 years. The 6,200-acre, life-of-project disturbance would hold true for reclamation of herbaceous species, but not for shrubs habitats to be returned to pre-existing conditions.

Indirect impacts due to dust from roads is expected to affect vegetation adjacent to roads, resulting in additional impacts across 15 to 30 percent of the ARPA. The primary effects expected are reduced photosynthetic capability for plants and reduced palatability of forage. For the purpose of this analysis, dust movement off roads was considered to be between 300 and 1,320 feet along with the estimated total miles or roads needed for gas development in the ARPA. Impacts vary considerably depending on wind speeds, season and duration of soil disturbing activities, and the timing of and amounts of rainfall to wash dust off the vegetation. Impacts to wildlife and livestock may vary depending on the season of use or other critical time

periods (i.e., migration) that may change due to annual climate, vegetation health, or management system.

Direct and indirect impacts to vegetation would affect specific plant communities to varying degrees depending on general abundance, browse use, topography, and difficulty of reclamation. The majority of development would occur in mountain and Wyoming big sagebrush vegetation cover types, since they occupy about 85 percent of the ARPA. However, long-term impacts to Wyoming big sagebrush would be much higher than to mountain big sagebrush.

Wyoming big sagebrush plant communities occur on sites with lower precipitation and poorer soils, which increases the difficulty in reclamation and the likelihood that only initial shrub reestablishment may occupy disturbed sites during the estimated 30–50 year life of project. This loss of shrub habitat from direct disturbance, coupled with minor increases in dust drifting off roads making nearby vegetation less usable, would result in up to a 10 percent reduction in available Wyoming big sagebrush habitat on state and private lands. Even though the majority of disturbance would not be in antelope and mule deer crucial winter range, it would be in adjacent transition range. With average browse rates on crucial winter range and adjacent transition range already at moderate levels (40 to 60 percent) during average winters and higher during severe winters, this reduction in usable habitat would lead to increased browse use levels that would result in plant mortality and continue the current downward trend in sagebrush cover and age-class structure.

For the most part, impacts described in this and sections below are primarily about CBNG wells, since the actual number and location of deep natural gas wells is unknown but limited to 200 at this point. However, development of deep natural gas wells in the Wyoming big sagebrush plant community would have the greatest impacts (versus other plant communities), because they would be compounding the impacts already described for CBNG development. In addition, approximately 8 percent of this cover type occurs on moderate to steep slopes that would be affected by increased gully erosion and desertification due to the influence of roads on overland hydrology.

In allotments where increased levels of grazing non-use are requested by the livestock permittees due to the rate and scale of field development, there would be effects to the vegetative resource. Plant material previously removed or trampled by livestock would be left largely ungrazed, resulting in increased litter, soil protection, and reduced runoff and erosion. Plant vigor may improve in some areas, but most allotments with rotational grazing already have good vigor of desired species. Reclamation efforts would benefit without being grazed by livestock. However, grasses would eventually out-compete forbs and shrubs in the absence of livestock grazing. In Wyoming big sagebrush transition and crucial winter range increased grass cover and vigor may, in combination with increased shrub browsing, reduce establishment of shrub seedlings. This would skew the age-class ratio and contribute to the long-term decline in Wyoming big sagebrush cover and density. Therefore, impacts from disturbance to this vegetation cover type would affect its abundance, health, and diversity across the region, exceeding the significance criteria.

Mountain big sagebrush sites occur in areas with higher precipitation and better soils, and should reclaim more easily than Wyoming big sagebrush sites if adequate reclamation techniques are employed. Whether these sites would return to pre-existing levels of sagebrush cover during the 30–50 year life of project is unknown. Following prescribed burns in this area

mountain big sagebrush has been documented recovering to original cover levels in 40 to 50 years. In field development, soil profiles and structure is altered, which will likely lengthen time needed for recovery of shrubs. The elevation this species occurs at also precludes it from receiving more than light browsing by big game species before it is protected by winter snow. Approximately one-fourth of this shrub type occurs on moderate to steep slopes, particularly in the vicinity of the Muddy Creek drainage, Muddy Mountain, and the Deep Gulch/Wild Cow area. These sites would be affected by increased gully erosion and desertification due to the influence of roads on overland hydrology. Therefore, impacts from disturbance to this vegetation cover type would affect its health and diversity on locations with moderate to steep slopes, exceeding the significance criteria in these areas. However, acreage loss from disturbance would not affect its overall abundance, health or diversity across the project area.

Alkali sagebrush is the third most common vegetation cover type within the ARPA, but is not common within this region or even within the State of Wyoming. The high clay content in the soils it grows upon has high runoff and severe water erosion potential once the protection of vegetation cover is removed, and increases the difficulty of reclamation. Although this species receives some browse use by wildlife and sheep, the use levels do not approach those documented for Wyoming big sagebrush. Therefore, impacts from disturbance to this vegetation cover type would reduce its overall abundance, and may affect its health and diversity across the region, exceeding the significance criteria.

Mountain big sagebrush/mountain shrub mix vegetation cover types occur on sandier sites around the Sand Hills and on steeper, north and east slopes where snowdrifts provide higher precipitation levels. The steeper slope sites would be avoided, so loss from project disturbance should be minimal. Sites around the Sand Hills contain high amounts of bitterbrush which is important to mule deer during the fall and winter and is not abundant elsewhere in the ARPA. Bitterbrush should be able to be reestablished on these sites, but not within the life of the project; therefore, impacts from disturbance to this vegetation cover type would affect its health and diversity in localized areas. However, acreage loss from disturbance would not affect its overall abundance, health or diversity across the project area.

The ability to reestablish native vegetation on sensitive soil types (i.e., clayey, sands, saline-sodic) is not well documented in this area, but may be in other locations. Although current technology exists to stabilize these areas and minimize soil erosion as revegetation is being carried out, there is currently a lack of local seed sources for native forb and shrub species, and the recovery rate to restore native shrubs (particularly Wyoming big sagebrush and alkali sagebrush) to their pre-existing condition is unknown. This would likely lead to a two-phased reclamation, initially grasses with weed control and 3–5 years later (or longer) interseed grasses with forbs and shrubs when native seed is available. Many of the potential impacts to the vegetation resource would be reduced assuming construction, maintenance, and operation of well pad sites and associated disturbances are in accordance with chapter 2 of this EIS, the Reclamation Plan (appendix B), the BMPs (appendix H), and RMP stipulations.

Surface disturbing activities would increase the potential for new infestation and spread of existing invasive plant species populations. On the other hand, prompt and successful reclamation would reduce the potential for these species to establish and spread. Assuming that existing weed populations on public lands would receive adequate treatments in the future, potential weed expansion onto public lands would not occur; therefore, weeds would not exceed the significance criteria.

4.5.3.3 Alternative A (No Action)

Under the no action alternative, direct and indirect vegetation impacts would continue from the Atlantic Rim pods. The lack of adequate weed control efforts in the first few years of the interim drilling period has already increased seed sources for weeds that would have to be controlled for several years at a minimum. Halogeton has been observed spreading outside areas of disturbance from CBNG development. Reclamation and weed control during the interim drilling period is a concern to BLM based on the lack of success. BLM will focus on adaptive management to improve reclamation success to disturbed areas.

The lack of sufficient dust abatement with the Atlantic Rim pods has indirectly impacted vegetation. Based on observations, this has resulted in impacts to an additional 15 to 30 percent of the interim drilling period development areas. Under the no action alternative, indirect impacts from dust would continue to reduce photosynthetic activity and growth in vegetation due to lack of sufficient dust control efforts.

4.5.3.4 Alternative C

Alternative C would proceed with development similar to the Proposed Action, but would limit the acres of disturbance or recommend avoidance to protect sensitive values. Examples of sensitive values are areas with steep slopes, soils with high runoff potential, and big game crucial winter range. Since about 95 percent of the ARPA is affected by one or more restrictions for sensitive values (map M-40), the total acres disturbed on federal minerals would be reduced by about 68 percent, with impacts in different plant communities affected to varying degrees. With less disturbance on public lands, the disturbance on private and state lands would increase 100 percent compared to the proposed action. This would increase disturbance in the mountain sagebrush plant communities on those lands.

For instance, alkali sagebrush grows on clay soils with a high runoff potential, so this community would have less than half the disturbance than a comparable site supporting Wyoming big sagebrush. However, sagebrush sites within 2 miles of active leks that qualify as nesting habitat would also have limited disturbance. In addition, locations on moderate to steep slopes would have reduced surface disturbance compared to sites on gentle slopes; this would further reduce desertification impacts caused by alterations to runoff hydrology from roads. These benefits would affect all plant communities on moderate to steep slopes.

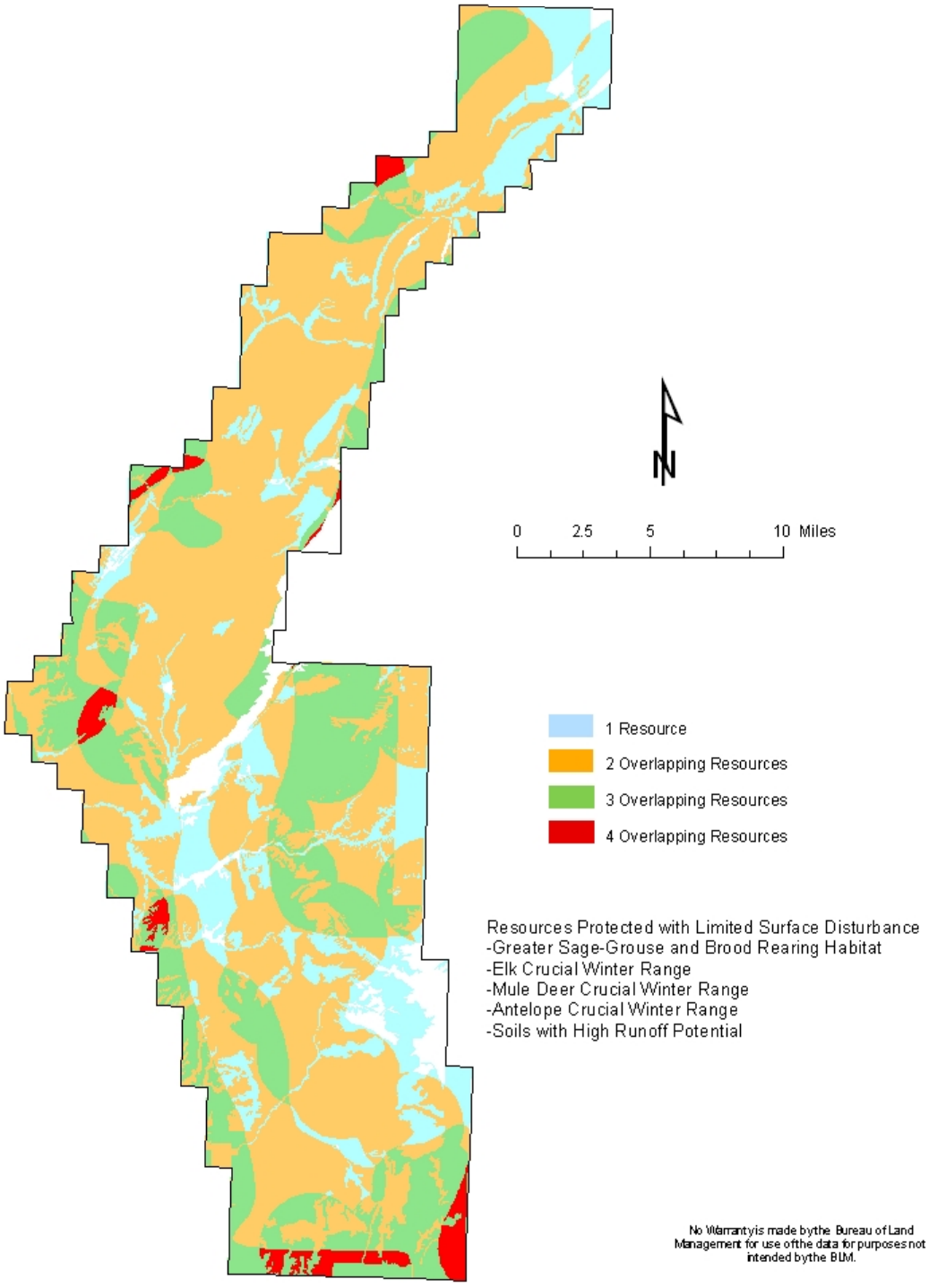
The additional mitigation measures would result in less acreage being disturbed, but some shrub species (Wyoming big sagebrush, Alkali sagebrush) still would not be replaced, removing the community's unique attributes or ability to support other resource values within the life of the project. Although disturbance would be greatly reduced, the allowed levels of disturbance in Wyoming big sagebrush coupled with existing impacts to this community, would continue the current downward trend in sagebrush cover and age-class structure, thereby exceeding the significance criteria.

The doubling of disturbance on private and state lands, where there are no operator committed measures to control weeds, address erosion issues, and meet reclamation standards would increase weed and erosion effects that would carry onto adjacent public sections. Mountain shrub communities important to wintering big game and other wildlife species would potentially be more affected through fragmentation or loss of habitat due to construction activities. This

would have effects to both upland and riparian plant communities, and lead to weeds exceeding the significance criteria on public lands.

This alternative would continue the likelihood of requests for total non-use of all grazing use by the livestock permittee due to the rate and scale of field development, but on a pasture or regional scale within allotments. Within these smaller development areas, the principle difference would be in reclamation success, as there would be no need for fencing of pads and other facilities to protect them from grazing until vegetation was sufficiently reestablished. Livestock grazing would not hinder reclamation success which would further reduce the potential for weed establishment.

Map M-40. Alternative C–Resources with Limited Surface Disturbance Mitigation Measure.



4.5.3.5 Alternative D

Alternative D would proceed with development similar to the Proposed Action, but would vary allowable disturbance within two categories and limit the acres of disturbance at any one time. Total disturbance acres would be 13,600 acres (13,000 new disturbance and approximated 600 acres of existing disturbance) or about 18 percent less than the Proposed Action. This alternative also has a goal of an average of 6.5 acres/well pad and a goal of less than 6.5 acres/well pad disturbance in Category A areas. Vegetation in avoidance areas would generally be protected, unless influenced by activities adjacent to these sites.

Shrub cover (Wyoming big sagebrush, Alkali sagebrush) still would not be replaced, removing the ability to support other resource values within the life of the project, thereby exceeding the significance criteria.

This alternative would continue the likelihood of requests for total nonuse of all grazing use by the livestock permittee due to the rate and scale of field development, but coordinated annually with permittees to allow them to plan around disturbance within allotments. Within these development areas, the principle difference may be in reclamation success. In locations with total nonuse, there would be no need for fencing of pads and other facilities to protect them from grazing until vegetation was sufficiently reestablished. Livestock grazing would not hinder reclamation success resulting in higher herbaceous cover on reclaimed sites. An increase in herbaceous cover would further reduce the potential for weed proliferation but may lower the establishment of shrub species. Therefore, impacts from disturbance to Wyoming big sagebrush and alkali sagebrush would affect its abundance, health, and diversity across the region, exceeding the significance criteria.

Surface disturbing activities would increase the potential for new infestation and spread of existing invasive plant species populations. On the other hand, prompt and successful reclamation would reduce the potential for these species to establish and spread. Assuming that existing weed populations on public lands would receive adequate treatments in the future, potential weed expansion onto public lands would not occur; therefore, weeds would not exceed the significance criteria.

4.5.4 Impacts Summary

Impacts from the Proposed Action would include direct removal of acreage of vegetation communities, and an indirect loss of usability from dust, thus decreasing abundance and redistributing use by livestock and wildlife that use these native species throughout the life of the project (or longer). Disturbance in Wyoming big sagebrush communities within mule deer and antelope transitional and crucial winter range would exacerbate the existing downward trend and add to the management issues that led to the failure of Rangeland Health Standards #3 (Upland Vegetation) and #4 (Wildlife Habitat). Sites located in the mountain big sagebrush cover type would recover with reclamation. In addition, the desertification of rangelands due to changes in overland hydrology on moderate and steep slopes would affect more than one-third of the ARPA. Project implementation would potentially reduce the amount and function of wetlands and other waters of the U.S due to accelerated erosion and sedimentation from adjacent moderate and steep slopes (appendix K, section K.1.3.7.2). Disturbance to most vegetation cover types would exceed the significance criteria and, with adequate control, weed presence would not exceed significance criteria.

Impacts for Alternative A would include disturbed land and associated loss of vegetation as described in the associated Atlantic Rim pod environmental assessment. However, the increase in presence and spread of weeds during the interim drilling period is a concern and must be addressed to achieve successful reclamation.

The additional mitigation measures for Alternative C would result in less acreage on public land being disturbed (but with the possibility of a corresponding increase in disturbance on private and state lands). Some shrub species (Wyoming big sagebrush, Alkali sagebrush) still would not be replaced, removing the ability to support other resource values within the life of the project, and mountain shrub communities and erosion effects to plant communities in the checkerboard land pattern would increase, thereby exceeding the significance criteria. Weed presence without operator commitment to treat weeds on private and state lands that would spread to public land would also exceed the significance criteria.

Alternative D would result in 18 percent less acreage being disturbed than the Proposed Action, and with less disturbance in Category A areas. However, in general, impacts would be the same as for the Proposed Action.

4.5.5 Additional Mitigation Measures

There would be no additional mitigation measures for the Proposed Action, Alternative A, or Alternative D.

Additional mitigation measures for Alternative C are detailed in appendix L “Resource Concerns and Associated Protection Measures Proposed under Alternative C”.

4.6 Rangeland Resources

4.6.1 Introduction

Impacts to range resources would result with implementation of the Proposed Action or any of the action alternatives. Potential impacts would occur throughout the life of the project, due to vegetation and soil disturbance associated with construction activities, reclamation, weed control, road issues (i.e., dust and animal collisions), fence maintenance, water management, and increased recreational use by the public.

4.6.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objective associated with rangeland resources:

- To enhance livestock grazing while maintaining a balance between economic uses and the enhancement of wildlife habitat, watershed, and riparian areas, while maintaining range condition at, or improving range condition toward, the potential for the ecological site.

Impacts to rangeland resources would be potentially significant if:

1. Resource management actions result in greater than 10 percent permanent reduction in AUMs available for livestock grazing in a given allotment,

2. Resource management actions reduce or eliminate the opportunity to run the livestock of choice, and

3. Wyoming BLM standards for Health Rangelands are not met.

4.6.3 Direct and Indirect Impacts

4.6.3.1 Direct and Indirect Impacts Common to All Alternatives

The ARPA includes lands that are located within 31 grazing allotments (described in section 3.6, table 3-31, and on map M-20). In many cases, the boundaries of these allotments extend beyond the boundaries of the ARPA; therefore, discussion of impacts will focus on the 20 allotments primarily affected. The remaining 11 allotments would have similar impacts, but very minor in scale. Under the Proposed Action and all alternatives, livestock grazing would continue throughout the duration of the project with stocking rate adjustments (and requests for temporary non-use) made annually by each livestock operation.

The primary impact to grazing resources would be short-term loss of available forage as a result of construction and production-related disturbance. Available forage would be reduced during drilling and field development and reclaimed as soon as feasible under direction of the Reclamation Plan (appendix B) and BLM. A permanent loss of forage would occur under any action approved for the construction of roads, portions of drill pads, and ancillary facilities that remain permanent during the life of the project. However, successful short-term reclamation of pipelines, portions of pads not necessary for long-term operations, and any other related disturbances should replace this short-term loss of forage. The potential exists for increased death loss of young livestock due to vehicle collisions following construction of new and higher speed roads.

The proposed project would result in increased traffic and increased speeds on the improved roads within the ARPA, particularly during the drilling and field development phase. The potential for livestock/vehicle collisions would be increased, especially during the calving/lambing season. Carbon County has already posted speed limits on the Twenty Mile road south of Rawlins. The potential also exists for disruptions to livestock management. Traffic along roads that pass through shipping pastures or by corrals when in use may interrupt or complicate this work, extending the time and increasing the cost to complete them. Herding of animals through areas being developed or moving around them would increase the complexity and time to accomplish these tasks. In some allotments, management flexibility may be sacrificed to avoid or to minimize these operational impacts. Benefits of better roads to livestock operations are varied and substantial in nature. They include improved access for viewing the allotment, facilities and animals, greater likelihood of observing and doctoring sick animals, and improved capability for trucking animals in or out of an allotment.

There is also potential for damage to BLM and livestock operator fences, gates, and cattle guards from the movement of heavy trucks, drilling equipment, and heavy construction equipment. The involved mineral companies would promote (if they don't already) a policy to report and correct damage to livestock facilities as quickly as possible, including contacting the permittee and the BLM. Closed gates that are left open or are damaged usually result in a scattering of livestock off the allotment and a considerable amount of time and expense for the livestock operator to roundup the loose livestock and return them to the pasture. This may

affect their breeding program, reduce weight gains of livestock, and reduce time available for other work.

Water resources would be affected by the proposed project. New water locations may be established in self-contained systems, similar to two water troughs and tanks already authorized on lands of Weber Ranch in the Doty Mountain allotment. These self-contained water systems help improve water distribution and provide water otherwise not available in dry years. Storage tanks and pipelines may be supplemented with water from CBNG development that may save in pumping costs during the life of the project. Existing water sources that dry up or have reduced flows due to water drawdown associated with gas field development may affect livestock operations in the short-term until alternative water sources are developed. If this does occur, mitigation would occur if it can be proven that the reduction in water is a result of CBM development, and would consist of either CBNG water of similar quality being substituted to replace the same volume of water no longer flowing or creating an alternate water source.

Disturbance of soils and increased vehicle activity would increase the potential for introduction, establishment, and spread of invasive non-native species. This can reduce forage availability and animal weight gains, in addition to affecting trail routes and animal health, particularly increasing death loss with sheep. Expansion of weeds and increased erosion from private and state lands without operator commitment to control them onto adjacent public lands would likely occur. Recently observed expansion of halogeton from disturbed sites into adjacent native rangelands demonstrates the concern that this problem can spread beyond sites of disturbance and affect thousands of acres. Prompt reclamation of disturbed sites would lessen the introduction and spread of weeds and would reduce the impact on livestock operations. However, lack of adequate weed control would lead to increases in invasive species. In the case of halogeton, this would likely eliminate the ability to graze sheep in this area. This would potentially lead to non-use of 1,588 AUMs and could result in one of two sheep operations going out of business due to lack of ability to graze and lamb sheep in other locations.

4.6.3.2 Proposed Action

The Proposed Action would result in an estimated initial disturbance of about 15,800 acres, which represents about 6 percent of the total land area of the combined 20 grazing allotments used by twelve livestock operations. This acreage of disturbance would result in the short-term loss of 2,026 AUMs. This development would happen incrementally, with reclamation of short-term disturbances probably making up for a portion of the forage lost. This is due to initial reclamation efforts being focused on site stability, with vegetation dominated by herbaceous (grass and forb) species. Since 91 percent of livestock AUMs are cattle, and cattle prefer grasses, reclamation should not just replace forage lost, but result in higher production of desired species. During the life of the project, this total amount of disturbance is estimated to decrease to about 6,200 acres, or between 2 and 3 percent of the combined land area of the allotments. This amount of forage affected is far less than the normal adjustments permittees have to make for market change or drought, for instance. Therefore, the loss of forage from disturbance from construction and production activities should be minimal in the short-term and may actually increase available forage in the long-term, and therefore benefit livestock operations. However, this may be more than offset by the lack of any commitment by the companies to control weeds on private and state lands.

Roads would contribute to increased dust that settles on vegetation resulting in lower palatability and shifting of use to other locations. Increased dust may also affect animal health by

increasing the likelihood of ailments such as dust pneumonia. These impacts could reduce weight gains or require lowering stocking rates in affected allotments. Application of measures to reduce dust, such as road construction and treatments, would reduce these impacts on public lands, but usable forage on state and private lands could be reduced by 15 to 30 percent, leading to more concentrated livestock use in dust-free locations. Roads on moderate to steep slopes that result in long-term changes in overland hydrology and desertification impacts below these locations could also lead to lower weight gains or require reduced stocking rates.

The greatest affect upon livestock operations will be the sum of the impacts described in section 4.6.3.1 and the paragraphs above, which is also dependent on the rate and extent of development and what amount of each operation it will impact. Although chapter 2 describes a 15- to 20-year development phase, approximately half of the projected 2,000 wells would be completed in the first 5 years. Based upon this information and where pods have been developed in the interim drilling period, impacts would be greatest (in descending order) upon five allotments: Doty Mountain, Cherokee, Fillmore, East Muddy, and Sixteen Mile allotments.

The Cherokee allotment is almost entirely within the ARPA and would have the next highest number of wells (approximately 300 in first 5 years) that affect seven different livestock operations. One operation consisting of 950 AUMs, uses this allotment for 6 months per year and would be most affected by disruptions due to development activities. The remaining six operations use the allotment more seasonally for about 2 months each and have other allotments where they could make some adjustments. Spring lambing occurs in May and June, which would receive some protection from disturbance due to their proximity to greater sage-grouse nesting habitat, as long as seasonal timing stipulations are required. This habitat used for spring lambing use, involving two operators (1,588 AUMs), would be difficult to replace in another location and is further complicated by the impact from weeds discussed above.

The Fillmore allotment would be the third most affected allotment with up to 200 wells in the first five years. This allotment is about two-thirds contained within the ARPA and has one livestock operation grazing cattle in the spring and summer. Impacts would be similar to Doty Mountain, with 3,374 BLM-permitted AUMs within this allotment. Since Fillmore is in the checkerboard, these AUM numbers will actually double, and the AUMs affected in Doty Mountain would increase about 50 percent also due to private lands.

Although well numbers would next be highest in East Muddy and Sixteen Mile allotments, the impacted acres and AUMs would likely only affect 10 percent or less of each livestock operation. Remaining allotments would be affected as long-term build-out from the pods occur, but development would not likely be as intense as those mentioned above. Knowledge gained in early field development would help reduce the impact upon outlying allotments.

4.6.3.3 Alternative A (No Action)

As explained in section 2.1.2, the no action alternative would allow the operators to only complete development of wells (200 maximum) already approved under the Atlantic Rim pod EAs and as guided by the IDP (appendix A). This affects the Doty Mountain, Cherokee, Fillmore, and Sixteen Mile allotments, listed in order by the number of wells in each (high to low). Due to this low number of wells spread across four good-sized allotments, there would be minor impacts in terms of forage lost or reduction in usability due to dust. This impact should be replaced by forage returning to use due to reclamation of short-term disturbances; however,

existing weeds and expansion with development under the interim drilling period where adequate treatment has not taken place will continue to pose problems for livestock operators.

Impacts of greater concern are those relating to death loss from vehicle collisions or poisonous plants and disruption of livestock management actions such as vehicular traffic through shipping pastures or altering sheep trailing routes to avoid facilities and halogeton. At this scale of development, these impacts should be negligible if coordination with permittees, field personnel awareness, and weed control measures occur. Whether existing water sources would be impacted due to water drawdown pumping is unknown. The potential for damage to livestock control structures would be minimal due to the level of development. Benefits to livestock operations from existing or new water sources and road infrastructure as a result of CBNG development would continue or be improved.

4.6.3.4 Alternative C

Alternative C would proceed with development across the ARPA similar to the Proposed Action alternative, but would limit the acres of disturbance on sensitive sites and to protect specific resource values and sites on public lands. Examples of some of these sites are steep slopes, soils with high runoff or erosion potential, big game crucial winter range, greater sage-grouse nesting habitat, and lambing areas. Since about 95 percent of the ARPA is affected by one or more restrictions for sensitive values (map M-40), the total acres disturbed on BLM-administered lands would be reduced by about 68 percent. Total acres disturbed on private and state lands would be similar to that described under the Proposed Action or could increase to compensate for lower disturbance limits on public lands. This would result in an estimated initial disturbance of about 13,286 acres, and would result in the short-term loss of 1,703 AUMs. In addition, field development would be planned on a pasture or regional basis within allotments with the livestock operators. This form of development would reduce impacts to livestock operations and allotments to varying degrees.

In general, allotments with more critical wildlife habitat may have lower limits on disturbance that would result in reduced forage lost or made unusable by dust. Allotments with soils sensitive to disturbance may require lower limits on disturbance or methods that would reduce erosion or speed up reclamation that would also lower impacts to livestock operations. However, even though the magnitude of disturbance is reduced, the number of wells and activities to develop them and associated facilities would still be the same as in the Proposed Action.

The discussion above would not change the most impacted allotments described in the Proposed Action section, which are Doty Mountain, Cherokee, Fillmore, East Muddy, and Sixteen Mile. Although impacts to vegetation, soils, and hydrology have all been reduced significantly on public lands, and these will benefit livestock operations, many factors associated with a fast rate of field development still exist. These include increased death loss due to vehicle collisions, unusable forage and shifts in distribution of use due to dust, disruptions to livestock management actions, and potential for damage to livestock control facilities. Planning field development by pastures or regions within allotments would allow livestock operators to plan and work around the disruptions associated with development, instead of having these occur across the whole allotment. This may still lead to reductions in livestock use through requests for temporary nonuse, but at a level where ranchers could still continue to graze a majority of their allotments.

4.6.3.5 Alternative D

Alternative D would proceed with development across the ARPA similar to the Proposed Action alternative, but with two categories of disturbance goals and a limit of 7,600 acres of unreclaimed disturbance at any one time. In general, allotments with more resource values requiring avoidance or limited disturbance (Category A on map M-7) would result in reduced forage lost. However, even though the magnitude of disturbance is reduced, the number of wells and activities to develop them and associated facilities would still be the same as in the Proposed Action. This would result in an estimated initial disturbance of about 13,000 acres, and would result in the short-term loss of 1,667 AUMs.

The discussion above would not change the most impacted allotments described in the Proposed Action section, which include Doty Mountain, Cherokee, Fillmore, East Muddy, and Sixteen Mile. Factors associated with a fast rate of field development still exist which include increased death loss due to vehicle collisions and poisonous plants, unusable forage and shifts in distribution of use due to dust, disruptions to livestock management actions, and potential for damage to livestock control facilities. Annual coordination and planning meetings would help livestock operators plan and work around the disruptions associated with development. This may still lead to reductions in livestock use through requests for temporary nonuse, but at a level where ranchers could still continue to graze a majority of their allotments.

4.6.4 Impacts Summary

4.6.4.1 The Proposed Action

Range impacts associated with the Proposed Action would include disturbed land and associated loss of available forage. Implementation of the Proposed Action would result in an initial loss of about 2,026 AUMs due to actual disturbance to forage during construction activities. During the life of the project, this total is estimated to be replaced and probably exceeded assuming reclamation efforts are successful. However, 1,588 sheep AUMs may not be usable due to poisonous plant expansion and lack of weed control on private and state lands that may spread to adjacent public lands. An additional 2,000 to 4,000 AUMs may also be unusable on an annual basis due to dust from roads. In allotments with the highest rates and extent of field development, there would likely be reductions in livestock use that could total 20,000 AUMs (both BLM and private) annually in increased requests for temporary nonuse by six or more livestock operations.

Based on the assumptions and estimates contained in this assessment and experiences with gas field development in adjacent areas, the Proposed Action would result in significant impacts to livestock operations due to increased death loss, unusable forage due to dust and expansion of non-native poisonous plants, declining rangeland health and forage productivity, and disruptions to livestock management actions. The potential would exist for damage to livestock control facilities and increased labor in corrective actions.

4.6.4.2 Alternative A (No Action)

Range impacts associated with the no action alternative would include disturbed land and associated loss of available forage as described in the Atlantic Rim pod EAs and associated POD environmental assessment. This would amount to less than 10 percent of the forage loss described under the Proposed Action, or between 150 to 200 AUMs. Since this impact is

spread across four large allotments, the short-term impact should be minimal. During the life of the project, this total is estimated to be replaced or exceeded assuming reclamation efforts are successful.

Due to the small scale of development in this alternative, there would be minimal impacts in terms of unusable forage due to dust, declining rangeland health and forage productivity, potential for damage to livestock control structures, and disruptions to livestock management actions. The level of livestock death loss will be dependent on future weed control efforts to control existing and expanding weed populations.

4.6.4.3 Alternative C

Range impacts associated with Alternative C would include disturbed land and associated loss of available forage. Implementation of the Alternative C would result in an initial loss of about 1,703 AUMs. During the life of project, this total is estimated to be replaced or exceeded assuming reclamation efforts are successful. However, an additional 3,000 to 6,000 AUMs may be unusable on an annual basis due to dust from roads, once full-field development is completed. In allotments with the highest rates and extent of field development, there would likely be annual requests for temporary nonuse that could total 5–10,000 AUMs by six or more livestock operations. However, this would be reduced (depending on how each livestock operation is affected) by planning development on a pasture or regional basis within each allotment.

Based on the assumptions and estimates contained in this assessment and experiences with gas field development in adjacent areas, Alternative C would result in significant impacts to livestock operations due to increased death loss, unusable forage due to dust, declining rangeland health and forage productivity, and disruptions to livestock management actions. The potential would exist for damage to livestock control facilities and increased labor in corrective actions.

4.6.4.4 Alternative D

Range impacts associated with Alternative D would include disturbed land and associated loss of available forage. Implementation would result in an initial loss of about 1,667 AUMs, which is less than Alternative C. During the life of the project, this total is estimated to be replaced or exceeded assuming reclamation efforts are successful. However, 1,588 sheep AUMs may not be usable due to poisonous plant expansion and lack of weed control on private and state lands that may spread to adjacent public lands. An additional 2,000 to 4,000 AUMs may be unusable on an annual basis due to dust from roads, particularly on private and state lands, once full-field development is completed. In allotments with the highest rates and extent of field development, there would likely be reductions in livestock use that could total 20,000 AUMs (both BLM and private) annually in increased requests for temporary nonuse by six or more livestock operations.

Based on the assumptions and estimates contained in this assessment and experiences with gas field development in adjacent areas, Alternative D would result in significant impacts to livestock operations due to increased death loss, unusable forage due to dust, and expansion of non-native poisonous plants, declining rangeland health and forage productivity, and disruptions to livestock management actions. The potential would exist for damage to livestock control facilities and increased labor in corrective actions.

4.6.5 Additional Mitigation Measures

4.6.5.1 The Proposed Action

Speed limits would be enforced by companies advising and disciplining their employees and contractors as necessary to comply with speed limits.

The operators would coordinate annually or more often when necessary with affected livestock operators to discuss (1) problems encountered during the past grazing season, (2) agreed-upon corrective actions, and (3) planned energy development and operations during the next grazing season. This meeting needs to occur on a date early enough to allow grazing permittees sufficient time to make decisions and allocate their resources for the upcoming grazing season.

4.6.5.2 Alternative A (No Action)

The operators would coordinate annually or more often when necessary with affected livestock operators to discuss (1) problems encountered during the past grazing season, (2) agreed-upon corrective actions, and (3) planned energy development and operations during the next grazing season. This meeting needs to occur on a date early enough to allow grazing permittees sufficient time to make decisions and allocate their resources for the upcoming grazing season.

4.6.5.3 Alternative C

No additional mitigation measures are proposed for Alternative C over and above that detailed in appendix L “Resource Concerns and Associated Protection Measures Proposed Under Alternative C”.

4.6.5.4 Alternative D

Speed limits would be enforced by the companies advising and disciplining their employees and contractors as necessary to comply with speed limits.

The BLM would require that the operators establish speed limits in the project area and promote adherence to them, and erect signs in lambing/calving areas, shipping pastures, or adjacent to working corrals to warn vehicle operators.

The operators would coordinate annually or more often when necessary with affected livestock operators to discuss (1) problems encountered during the past grazing season, (2) agreed-upon corrective actions, and (3) planned energy development and operations during the next grazing season. This meeting needs to occur on a date early enough to allow grazing permittees sufficient time to make decisions and allocate their resources for the upcoming grazing season.

The operators would report damage to livestock and livestock facilities as quickly as possible to BLM and affected livestock operators.

4.7 Wildlife

4.7.1 Introduction

The principal wildlife impacts likely to be associated with the Proposed Action or action alternatives include (1) direct and indirect loss of wildlife habitats, (2) displacement of some wildlife species from increased human access and activity, (3) an increase in the potential for collisions between wildlife and motor vehicles, (4) an increase in stress to wildlife and (5) disruption of life history requirements of a species or population segment.

In addition, an analysis of potential wildlife concerns within each section of the ARPA was conducted so that operators could take the locations of these potential concerns into account when planning and selecting eventual well locations. Mitigation measures that correspond to the respective types of wildlife impacts within any given section would be implemented.

The primary wildlife resource concerns known to be present within the ARPA include big game crucial winter/transitional ranges; big game migration routes; overlapping big game crucial winter range (multiple species); leks, nesting habitat, and severe winter relief habitat of greater sage-grouse leks and nesting habitat of Columbian sharp-tailed grouse; and raptor nests.

The wildlife map (map M-29) represents the currently known locations of wildlife resource concerns within the ARPA. As more field data are gathered, additional areas that include wildlife resource concerns may be identified and mapped. If development occurs in areas of overlapping wildlife resource concerns, mitigation measures for each individual resource would be implemented. This approach provides the operators with information that can be used when developing gas well placement plans. Planned placement of disturbances may avoid individual wildlife resource concerns or overlapping concerns present within a section.

4.7.2 Impact Significance Criteria

The Great Divide Resource Area RMP ROD (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with wildlife resources:

- To provide habitat quality (food, cover, space, and water) adequate to support a natural diversity of wildlife and fisheries including big game; upland game; waterfowl; non-game species; game fish; sensitive, threatened, and endangered species; and species of special management interest in Wyoming as well as to assist in meeting goals of recovery plans.

- To maintain or improve vegetation condition or avoid long-term disturbance in high priority standard habitat sites and fisheries areas.

- To maintain or improve overall ecological quality, thus providing good wildlife habitat, within the constraints of multiple-use management in moderate and low priority standard habitat sites.

The following criteria were considered in the assessment of impacts associated with the Proposed Action and alternatives and are the same as those contained in the Draft Rawlins RMP DEIS (USDI-BLM 2004c):

1. Substantial loss of habitat function or disruption of life history requirements of a species or population segment that would make them eligible for listing under the ESA.

2. Decreased viability or increased mortality of threatened and endangered, proposed, and candidate species or reduction or alteration of their critical habitats.

3. Management actions that result in substantial disruption or irreplaceable loss of vital and high value habitats as defined in the WGFD (2004c) Mitigation Policy.

4. Substantial loss of habitat function or disruption of life history requirements of special status species that would preclude improvement of their status. Habitat function means the arrangement of habitat features and the capability of those features to sustain species, populations, and diversity of wildlife over time (WGFD 2004c).

4.7.3 Direct and Indirect Impacts

4.7.3.1 Direct and Indirect Impacts Common to All Alternatives

Applicant voluntarily committed measures (appendix K) and the BMPs (appendix H) would be implemented under all alternatives. The Wildlife Monitoring and Protection Plan (appendix E) would be followed to prevent, reduce, and detect impacts to wildlife and fish species throughout the life of the project. This plan serves two purposes. One is to describe the protocols to monitor wildlife responses, habitats, behavioral shifts, etc. The other is to provide protocols to protect wildlife species and track the effectiveness of the monitoring plan. BMPs implemented for other resource concerns may provide indirect protection for a variety of wildlife species.

Wildlife habitats directly affected by the proposed project include areas that are physically disturbed by the construction of pads, roads, pipelines, and production facilities; wildlife habitats indirectly disturbed include areas surrounding directly impacted habitats. Disturbance during construction and production, such as human presence, dust, and noise may displace or preclude wildlife use of disturbed areas. Wildlife sensitivity to these impacts varies considerably with each animal species.

Prohibiting construction, drilling, and other activities potentially disruptive to wildlife during sensitive time periods (i.e., winter, brood-rearing) would minimize the probability of displacement, nest abandonment, or reproductive failure during these critical times of the year. To reduce human presence, remote monitoring of project facilities, gating of roads, and noise reduction techniques should be used to the greatest extent possible during the production phase. However, habitat loss would still occur outside of this time period, as development would be allowed. In addition, it does not address the displacement of animals/loss of critical habitat due to the presence and operation of wells, facilities, and roads after construction is complete.

Displacement is unavoidable in the short term under all action alternatives, and this displacement has the potential to have the most significant effect on wildlife. Avoidance of disturbed areas would result in wildlife displacement from an area larger than the actual disturbed sites. The extent of displacement would be related to the duration, magnitude, and the visual prominence of the activity, as well as the extent of construction and operational noise

levels above existing background levels. Visual prominence of facilities is dependent upon surrounding topography.

Displacement would result in local reductions in wildlife populations if adjacent, undisturbed habitats are at carrying capacity. In this situation animals are either forced into less optimal habitats or they compete with other animals that already occupy unaffected habitats. Possible consequences of such displacement are lower survival, lower reproductive success, lower recruitment, and ultimately lower carrying capacity and reduced populations (WGFD 2004d).

Reaction of animals to noise and human presence varies depending on the intensity of the noise source and whether it is continuous or intermittent. Transient loud noises would provoke alarm responses; however, many animals learn to ignore more constant, lower-level noise sources that are not associated with negative experiences such as being chased or hunted (Busnel 1978).

The extent of wildlife displacement is impossible to predict for most species since the response severity varies from species to species and can even vary between different individuals of the same species. After initial avoidance, some wildlife species (usually certain birds and rodents and to a lesser extent deer and pronghorn) may acclimate to the activity and begin to reinvade areas previously avoided. This acclimation and reoccupation would be expected to occur following construction and drilling when the project moves into the production phases where less noise and human activity would take place.

Construction and drilling noise have the potential of affecting wildlife species at the project site as well as areas surrounding disturbance sites. Man-made construction such as well pads and roads can reduce use of surrounding habitat by wildlife. These impacted sites reduce foraging due to the direct loss of native vegetation from ground disturbance. In addition, there is an area surrounding these sites that tends not to be used due to the increased human activity. This zone can extend up to 0.625 mile from the developed area for pronghorn (Easterly et al. 1991) and from 0.6 to 1.2 miles for elk depending upon the season (Powell 2003). Consequently, development impacts to wildlife can extend farther off site than the actual amount of disturbed area. Although some individual animals can habituate to the increased infrastructure, it is generally assumed that, over all, the increased human footprint on a previously lightly developed area is detrimental to big game species. In addition to the avoidance response, increased human presence intensifies the potential for wildlife-human interactions ranging from the harassment of wildlife to poaching and increased legal hunting pressure. Also, increased traffic levels on new and existing roads could increase the potential for wildlife-vehicle collisions. Following drilling and well completion operations, noise levels would be reduced because well pumps would be powered by muffled generators. As a result, species might acclimate to the well pad production facilities and use habitats immediately adjacent to such sites. This has been observed at other natural gas production sites in Wyoming.

Direct habitat loss from construction would equal approximately 6 percent of the project area. In addition, dust would directly and indirectly impact 15–30 percent more acreage (section 4.5.3.1). These impacts would include habitat avoidance. Indirectly, this may increase inter- and intra-species competition for forage and thermal cover. In areas already fully occupied, density-dependant species would be further displaced, possibly outside of the project area. This may force animals to use lower quality habitats, which may lead to a reduction in reproduction rates or an increase in predation. The long-term loss/reduced usability of shrub habitat would lead to an increase in use on remaining shrub habitats. This increase of use would then lead to a

long-term reduction of shrub habitats outside the immediate project disturbances. A further reduction of shrub habitat from die-off caused by overuse would further reduce the habitat quantity and quality available in the long term, resulting in a significant impact.

Juniper/true mountain mahogany/serviceberry/silver sagebrush/bitterbrush plant communities would be avoided across the project area. This would aid in efforts to restore them to a more healthy condition to meet Rangeland Health Standard #3. These vegetation communities provide important habitat components for big game and grouse.

Habitat fragmentation and isolation are difficult to determine and vary species to species, but they could occur as a result of gas field developments, which are typically configured as point and linear disturbances scattered throughout broader areas. Although these types of disturbances do not usually create physical barriers to wildlife movement, the effective use of adjacent undisturbed habitats could diminish as densities of well pads, ancillary facilities, and roads increase.

Reclamation of disturbed areas along pipeline ROWs, road ROWs, and unused portions of well pads would result in re-establishment of vegetation in these areas over a relatively short time period. Revegetation would continue with the subsequent reclamation of abandoned well sites. Grasses and forbs are expected to become established within the first several years following reclamation; however, shrub re-establishment to pre-disturbance levels would not be achieved during the life of this project. Consequently, the total acres disturbed would constitute a long-term loss of shrubs and would not be usable by species dependant upon the shrub component for forage or shelter.

To protect breeding grounds and raptor nest sites, the BLM places a buffer around leks and nests where CSU is stipulated (USDI-BLM 1990). The buffer around the leks located within the project area covers 8,440 acres or 3.1 percent of the ARPA. The buffer around nests covers 17,846 acres or 6.6 percent of the project area. Therefore, most these areas would remain undisturbed for the life of the project.

General Wildlife (Species Other than Described in Sections Below)

The disturbance of wildlife habitat would reduce habitat availability for a variety of small birds and mammals. The temporary disturbances that would occur during the 20-year construction period would tend to favor early succession wildlife species, such as ground squirrels and horned larks, and would have more impact on mid-to-late-succession species, such as sage sparrows, sage thrashers, and voles. The long-term disturbance acres would have a minor effect on wildlife species not dependant upon shrubs. In addition to the direct disturbance acreage, dust would directly and indirectly impact 15 to 30 percent more acreage (section 4.5.3.1). These impacts would include habitat avoidance by birds, mammals, and insects. Indirectly, this may increase inter- and intra-species competition for nesting and foraging areas. In areas already fully occupied, density-dependant species would be further displaced possibly outside of the project area. This may force animals to use lower quality habitats, which may lead to a reduction in reproduction rates or an increase in predation.

The primary songbirds (common and BLM-sensitive species) that may be displaced by the reduction in habitat are vesper sparrow, green-tailed towhee, lark sparrow, sage sparrow, sage thrasher, loggerhead shrike, and Brewer's sparrow. Although there is no way to accurately quantify these changes, the displacement would be long term. Birds are highly mobile and would disperse into surrounding areas and use suitable habitats to the extent that they are

available. The long-term loss/reduced usability of shrub habitat would lead to an increase in use by all species including big game (See big game section below) on remaining shrub habitats. This increase of use would then lead to a long-term reduction of shrub habitats outside the immediate project disturbances. A further reduction of shrub habitat from die-off caused by overuse would further reduce the habitat quantity and quality available for shrub-dependant birds. Standard mitigation measures would indirectly help songbirds during critical time periods; however, impacts on nesting and foraging habitats would be significant. The magnitude of habitat loss, and continued human presence during the production phase of the project, would exceed the significance criteria (criteria numbers 3 and 4).

The primary small mammals found on the project area include, but are not limited to, cottontail rabbits, deer mice, various vole species, pocket gophers, white-tailed jackrabbits, Richardson's ground squirrels, and white-tailed prairie dogs. The initial phases of surface disturbance would result in some direct mortality and displacement of small mammals from construction sites. Quantifying these changes is not possible because population data are lacking. However, the impact is likely to be minor, and the high reproductive potential of these small mammals would enable populations to quickly repopulate the area following interim reclamation. Most of these species would benefit from an increase in grass-dominated vegetation from reclamation.

Development of the project may result in some direct mortality of small birds and small mammals from vehicle collisions; however, this mortality is expected to be negligible and is not likely to significantly reduce populations within the ARPA.

Big Game

Impacts to big game species may include (1) the removal and modification of habitat, (2) displacement due to increased human activities, (3) increased potential for vehicular collisions due to increased traffic levels on existing highways, and (4) increased potential harvest success due to easier access. The magnitude of disturbance to big game species would depend upon the season the area is used by each species, the ability of a species to habituate to disturbance, the corresponding drilling schedule, and the density of well field development. In addition, some big game animals may not move to other habitats or other suitable habitats may not be available to them. Therefore, the inability to relocate would result in increased stress from competition for forage and cover.

The WGFD classifies big game crucial winter range as vital habitats and recommends that habitat function be maintained so that the location, essential features, and species supported by the habitat are unchanged (WGFD 2004c). The application of BLM seasonal restrictions to prevent drilling on crucial winter range between November 15 and April 30 reduces the displacement and disturbance of big game during the most critical season. During operations, mitigation measures such as remote monitoring and telemetry would be used to reduce, but not completely eliminate, impacts to big game.

Timely reclamation of well pads, pipelines, and ROWs would provide grass and forb forage within a few years, while sagebrush and other important shrub species would require longer for re-establishment to pre-disturbance levels. With average browse rates on crucial winter range and adjacent transition range already at moderate levels (40–60 percent) during average winters (Warren 2006) and higher during severe winters, this reduction in usable habitat would lead to increased browse use levels that would result in plant mortality. A 10-year clipping trial study conducted by Colorado State University indicated that repeated plant removal above 60 percent resulted in increased plant mortality of big sagebrush. Displacement of animals, due

to project-related activities onto either of these ranges for a longer time period would increase overall browse use levels on both transition and crucial winter range above 60 percent, which would result in plant mortality, lower vigor, and declining cover of remaining Wyoming big sagebrush plants.

Pronghorn Antelope

The 42,900 acres of pronghorn crucial winter/yearlong range are located along the western edge of the ARPA (map M-21). Approximately 43.5 percent (BLM GIS calculation) of the crucial winter/yearlong range in the Baggs pronghorn herd unit is within the ARPA. The remainder of the ARPA is classified as winter/yearlong or spring/summer/fall range.

Standard mitigations prohibiting construction, drilling, and other activities potentially disruptive to pronghorn within crucial winter range from November 15 to April 30 would reduce the probability of displacement during this critical time of the year. During the production phase, there is no equivalent mitigation and animals may be displaced up to 0.25 miles from the source (USDI-BLM 2004c). This would lead to increased stress/decreased condition or reproductive rates of the animals as they travel farther and may have to use lower-quality range. To reduce human presence, remote monitoring of project facilities would be used to the greatest extent possible during the production phase.

Several general pronghorn migration routes transverse the ARPA; it is unknown how critical these routes are. This project could alter or block pronghorn movements along existing migration routes.

In addition to the direct removal of habitat due to the development of pads and associated ancillary facilities, disturbances from drilling activities and traffic would affect use of the habitat adjacent to these areas. However, pronghorn have been found to habituate to increased traffic volumes and heavy machinery as long as the machines move in a predictable manner (Reeve 1984). Well development operations and deviation from ordinary activities may cause antelope displacement of up to 0.625 miles (Easterly et al. 1991), but they would likely habituate to activities along roads and continue using habitats in those areas (Reeve 1984). The magnitude of displacement would decrease over time as (1) the animals have more time to adjust to the circumstance and (2) the extent of the most intensive activities such as drilling and road building diminishes and more wells are put into production. By the time the field is under full production, construction activities would have ceased, and traffic and human activities would be reduced.

The perception of pronghorn use in and near oil and gas development projects is that some individuals may habituate to project construction and operational activities in both the short and long term. Over time, some individuals may habituate to certain disturbances, depending on the spatial relationship (i.e., distance) between these areas of disturbance to available forage, water, and thermal cover. However, this is true for only certain individuals within a population. Other individuals may exhibit a lower tolerance to human-related activity. Therefore, animals within a population may respond differently to construction and operational activity. BLM RFO biologists have noted anecdotally that antelope herd sizes are significantly smaller in impacted areas than in relatively pristine areas. Those animals that potentially acclimate seem to do so only in smaller herd sizes. In undisturbed areas, the herds are much larger and show flight responses at much greater distances than in disturbed zones. Minimizing human presence at well sites after they have been put into production and timely reclamation of well pads, pipelines, and ROWs would help reduce displacement of pronghorn from the well field.

However, fences along Highway 789 create a migration barrier not allowing pronghorn to move from east to west across the highway. Pronghorn found east of this highway are restricted to crucial winter habitat found along Muddy Creek and against Highway 789, creating a trap to animal movement. The State of Wyoming has constructed a section of lay-down fence, unrelated to the ARPA, to help reduce this effect.

Mule Deer

The 74,492 acres of mule deer crucial winter and crucial winter/yearlong range are located within the ARPA (map M-23). Approximately 27 percent of the crucial winter and crucial winter/yearlong range in the Baggs mule deer herd unit is within the ARPA. Forty-two percent of this crucial winter range is on private and state land and is afforded no protection (section 3.7.2.2). Therefore, loss of this crucial winter range is likely during the life of project leading to increased use on public land crucial winter range. Construction activities remove crucial winter range vegetation and increase noise and human activity levels which displaces animals. The critical shrub component removed within crucial winter range would not be replaced (with potentially the exception of mountain sagebrush) to pre-development levels during the life of the project.

Prohibiting construction, drilling, and other activities potentially disruptive to mule deer within crucial winter range from November 15 to April 30 would reduce the probability of displacement during this critical time of the year. During the production phase, there is no equivalent mitigation and animals may be displaced up 0.75 miles from the source (USDI-BLM 2004c). This would lead to increased stress/decreased condition or reproductive rates of the animals as they travel farther and may have to use lower quality range. To reduce human presence, remote monitoring of project facilities would be used to the greatest extent possible during the production phase.

Several mule deer migration routes transverse the ARPA. A research project initiated by the BLM and WGFD in February 2005, funded by two of the operators, should help delineate the migration routes used by mule deer on the ARPA. When information is available from this research, additional mitigation would be placed on development for the protection of mule deer migration corridors. Meanwhile, this project could alter or block mule deer movements along existing migration routes.

In addition to the direct removal of habitat due to the development of pads and associated ancillary facilities, disturbances from drilling activities and traffic would affect the use of the habitat immediately adjacent to these areas. Mule deer, however, are adaptable and may adjust to non-threatening, predictable human activity (Irby et al. 1988 and Gusey 1986). However, the Sublette Mule Deer Study, which used Global Positioning System (GPS) collars, found that winter mule deer habitat selection and distribution patterns have been affected by development, specifically road networks and well pads. Sawyer found no evidence of acclimation behavior. During 3 years of study, mule deer had higher probability of use in areas farther away from well pads as development progressed. Predictive maps also suggest that some habitats considered “high probability of use” areas prior to development, changed to “low probability of use” areas as development progressed, and visa versa.

Indirect habitat loss can be substantially greater than the direct loss of habitat to roads and well pad construction. Reduction in winter range size and quality of available habitat may decrease the carrying capacity of the overall winter range (Sawyer et al. 2004). This suggests that within the ARPA, indirect impacts such as displacement from activities, dust from roads, and

competition for forage within the already poor condition crucial winter range habitat may lead to reduced mule deer numbers and die-offs from animals going onto crucial winter range in poorer health with reduced body reserves.

Elk

Approximately 41,000 acres or 20 percent of the crucial winter/yearlong range in the Sierra Madre elk herd unit is within the ARPA (map M-24). Several elk migration routes transverse the ARPA; however, it is unknown how critical these routes are. This project could alter or block elk movement along existing migration routes.

Construction activities remove crucial winter range vegetation and increase noise and human activity levels which displace animals. However, much of the crucial winter range is on steeper south- and west-facing slopes that would be avoided during development. The amount of vegetation disturbed is not as important as the noise and activity levels that would still occur and result in displacement of elk. In addition to the direct removal of habitat due to the development of pads and associated transportation facilities, disturbances from drilling activities and traffic would affect use of the habitat adjacent to these areas (Powell 2003). Elk are more sensitive to human activities than pronghorn or mule deer, and they may be displaced in construction areas from 0.6 to 1.2 miles for elk depending upon the season (Powell 2003). Displacement would be reduced in areas with topographic barriers (Edge and Marcum 1991). Elk would likely habituate to the physical presence of gas wells (Ward et al. 1973, Ward 1976, Hiatt and Baker 1981, Perry and Overly 1976). However, elk rarely adjust to continued human presence required during the production phase of the project (Thomas and Toweill 1982). With the increase in roads and potential recreational access to the area, displacement of elk is extremely likely during all phases of development. During the production phase, there is no equivalent mitigation and animals may be displaced up to 1 mile from the source (USDI-BLM 2004c). This would lead to increased stress/decreased condition or reproductive rates of the animals as they travel farther and may have to use lower-quality range. To reduce human presence, remote monitoring of project facilities would be used to the greatest extent possible during the production phase.

Overlapping Big Game Crucial Winter Range

Areas of overlapping big game crucial winter range are of greater importance because they provide crucial habitat for more than one species of big game. There are several areas of overlapping big game crucial winter range located within the ARPA (map M-25). The combinations of overlapping big game crucial winter range include the following: elk/mule deer, 3,038 acres and mule deer/antelope, 22,637 acres. Forty percent of this habitat is on private and state lands where there are no protections against disturbance of animals during crucial time periods.

Indirectly, this may increase inter- and intra-species competition for forage and thermal cover; in areas already at carrying capacity, density-dependant species would be further displaced. This may force animals to use lower-quality habitats, which may lead to a reduction in reproductive rates or an increase in predation.

Upland Game Birds

Greater Sage-Grouse. Greater sage-grouse are abundant within the ARPA, due to the high amount and diversity of suitable habitat, lack of habitat fragmentation, and the close proximity of upland and riparian habitats. In addition, all habitats needed to fulfill the life history requirements of this species are found adjacent to one another. Potential impacts to greater

sage-grouse include loss of nesting or early brood-rearing habitat, decreased population productivity caused by loss of nesting or early brood-rearing habitat, reduced utilization of suitable habitats due to indirect disturbance, loss of winter habitat, increased predation due to increased roosting sites for raptors on power poles and other structures, and displacement of birds into lower quality habitats.

Potential sources of direct impacts to greater sage-grouse include excessive noise levels proximal to occupied leks; disruptive human activities that occur during the daily time period in which courtship and breeding, nesting, brood-rearing, and foraging activities take place; and habitat loss from construction of project facilities. Noise levels interfere with bird communication during mating periods resulting in lower bird attendance at leks. Disruptive human activities alter normal bird behavior, increase nest abandonment, and may displace birds into less-desirable habitats. Construction of facilities and roads creates a long-term loss of greater sage-grouse habitat, increases fragmentation of remaining habitat. Increased predation due to facilities, such as well houses, compressor stations, and aboveground power lines serving as perches for raptors and corvid's can result in long term loss. Roads may also serve as travel corridors for some predators, such as foxes and coyotes. All of these impacts lead to lower productivity and long-term decline in the population of this species.

Of greater concern is the indirect loss of habitat resulting in bird displacement and fragmentation of nesting and early brood-rearing habitat. Sources of indirect impact primarily relate to dust settling on vegetation and loss of sagebrush habitat due to over-browsing by antelope and mule deer. Dust reduces the palatability and production of forbs and shrubs used by grouse. Over-browsing by big game on ranges shared with grouse would reduce quality and abundance of nesting, brood-rearing, winter habitats, and forage.

Potential greater sage-grouse nesting habitat covers 92 percent of the ARPA. In the long-term, recovery of shrubs to pre-disturbance levels would not occur during the life of the project. Therefore, there would be a long-term loss of nesting habitat.

Sage-grouse may repopulate an area following energy development, but may not attain population levels that occurred before development (Braun 1998). Most nests abandoned are directly or indirectly related to human activity. Likelihood of abandonment is higher when nests are disturbed early in the incubation period (Remington and Braun 1991).

Naugle et al. (2006) found that leks along the edge of CBNG development had higher lek attendance than leks within the developed area. The hypothesis that sage-grouse avoid developed areas is supported by the finding that active leks and leks with moderate to large numbers of males were often found adjacent to CBNG fields but rarely within CBNG. In contrast, inactive leks and leks with few males were often found within CBNG fields. One of the most striking patterns discovered was that, of leks counted in either 2004 or 2005, no medium or large-sized leks occurred within CBNG development; all remaining leks in CBNG have 20 or fewer males. Summary statistics for well and power line variables calculated from GIS layers around active and inactive leks indicate that active leks typically are twice as far from wells, one-half times as far from power lines, have one-third the density of wells, one-half the density of power lines, and generally have less development (wells and power lines) within 3.2 kilometers (km) of the lek complex. In addition, a significantly higher proportion of lek complexes are inactive in CBNG areas compared to areas on the edge of or outside CBNG (excluding lek complexes of unknown status and those destroyed by agriculture or mining).

Columbian Sharp-Tailed Grouse. Six occupied Columbian sharp-tailed grouse lek locations have been documented on or within 1 mile of the ARPA, which comprises 27 percent of the leks within the BLM RFO land management area (map M-27). Potential Columbian sharp-tailed grouse nesting habitat (habitat located within 1 mile of an occupied lek) covers 4,956 acres or 1.8 percent of the ARPA (section 3.7.3.2). Leks are not located on BLM lands; however, 785 acres of nesting and brood-rearing habitat are located on BLM lands. These leks represent the northernmost extent of the known distribution of Columbian sharp-tailed grouse, and may represent 27 percent of the leks known to occur in Wyoming. Wintering habitat for sharp-tailed grouse (serviceberry/mixed mountain shrub habitat) totals 287 acres, of which 278 acres are on BLM land.

Potential sources of impact to sharp-tailed grouse include excessive noise levels proximal to occupied leks, and disruptive human activities that occur during the daily time period in which courtship and breeding activities take place. As no leks are located on BLM-managed lands, the potential for disturbance during courtship and breeding periods is likely as there are no timing restrictions for surface disturbing or other disruptive activities. Also, in the long-term, recovery of shrubs to pre-disturbance levels would not occur during the life of the project for sharp-tailed grouse nesting and brood-rearing habitat.

The application of avoidance and mitigation measures on BLM lands would help to reduce stress to sharp-tailed grouse during nesting and brood-rearing periods. There are no measures to protect the habitat from being removed by project activities outside this spring period on BLM lands or at any time on private and state lands.

Wintering Areas for Grouse. Wintering areas (as they are mapped) would be protected from surface disturbing activities from November 15 to March 14. Activities would be allowed outside this timing period and habitat could be removed. This would result in habitat loss as well as potential displacement of wintering birds.

Approximately 200 acres of severe winter relief areas (SWR), of which 174 acres are on BLM land, have been identified and mapped so far. Mapped wintering habitat for sharp-tailed grouse (serviceberry/mixed mountain shrub habitat) totals 287 acres, of which 278 acres (97 percent) are on BLM land. Surface-disturbing activities would be prohibited in serviceberry/mixed mountain shrub habitat and SWR, which would also protect this wintering habitat for grouse.

Raptors

The potential impacts that the project could have on raptors include nest abandonment and reproductive failure due to project activities or increased human disturbance, reductions in prey populations, mortality from vehicle collisions, loss of nesting habitat, decreased population recruitment, and reduced use of suitable habitats.

There are 357 raptor nests located within the ARPA, with an additional 185 raptor nests within 1 mile of the ARPA boundary (1 mile seasonal protection) totaling 542 nests. The total acreage around nests, buffered by 1 mile of seasonal protection, totals 173,483 acres or 64 percent of the ARPA.

Development of the project would disturb habitat for several prey species. The amount of short-term change in prey base populations created by construction is expected to be minimal in comparison to the overall level of small mammal populations. While prey populations on the project area would likely sustain some reduction during the development phase of the project,

most prey species would be expected to rebound to pre-disturbance levels following initial reclamation. Once reclaimed, these areas would likely promote an increased density and biomass of small mammals that is comparable to those of undisturbed areas (Hingtgen and Clark 1984). For these reasons, no measurable long-term reductions are anticipated to the prey base. However, prey populations may be displaced due to dust and habitat loss. In turn, those raptors (i.e., prairie falcon and burrowing owl) dependant on small birds and insects may be indirectly affected.

Some raptors feed on carrion on and along the roads, while others (owls) may attempt to capture small rodents and insects that are illuminated in headlights. These raptor behaviors put them in the path of oncoming vehicles where they are in danger of being struck and killed. The potential for such collisions can be reduced by requiring that drivers undergo training that describes the circumstances under which vehicular collisions are likely to occur and measures that can be taken to minimize them.

Fish

Refer to section 4.8 for impacts to sensitive fish species.

4.7.3.2 Proposed Action

Development would alter or remove approximately 15,800 acres of wildlife habitat over the next 20 years. However, reclamation of disturbed habitats would commence immediately and continue throughout the 20-year construction period, resulting in a short-term recovery of grass-dominated habitat. This reclamation would reduce the area disturbed by 60 percent down to 6,240 acres. Long-term recovery of shrubs to pre-disturbance levels would not occur during the life of the project. On average, there would be 63.2 acres of pre- and 24.8 acres of post-reclamation disturbance with the maximum eight pad locations per section.

Impacts are the same as identified in section 4.7.3.1 above, except as discussed below.

General Wildlife (Species Other than Those Described in Sections below)

The long-term disturbance would have a minor effect on wildlife species not dependant upon shrubs. Impacts to songbirds that are dependant upon shrub habitats for nesting and foraging would be significant. The magnitude of habitat loss, and continued human presence during the production phase of the project (as discussed in section 4.7.3.1, General Wildlife), would exceed the significance criteria (criteria numbers 3 and 4).

Big Game

Pronghorn Antelope. The acreage disturbance and the actual number of pads per section would fall under a high impact post-reclamation. The direct loss/reduced usability of Wyoming big sagebrush would increase use on remaining shrubs, resulting in shrub health decline outside the immediate project disturbances. This would have the greatest impact to antelope due to their extreme reliance upon sagebrush (96 percent of their diet) during winter. This level of development within pronghorn crucial winter range, compounded by the current condition of the crucial winter habitat would exceed the significance criteria (criterion number 3).

Mule Deer. The acreage disturbance and the actual number of pads per section would fall under a high impact post-reclamation. This level of development within mule deer transitional

range and crucial winter range, compounded by the current poor condition of the crucial winter habitat, would exceed the significance criteria (criterion number 3).

Elk. Although actual acreage disturbance would fall under a "high" impact post-reclamation, there would be an "extreme" impact to elk based on the actual number of pads (eight pads per section) (WGFD 2004c). With this level of development, impacts to elk crucial winter range would exceed the significance criteria (criterion number 3).

Upland Game Birds

Greater Sage-Grouse. Proposed Action habitat disturbances would equate to a maximum direct loss of 10 percent of the available nesting habitat (eight locations per section with associated roads and facilities). However, the acreage disturbed by this alternative would fall into the high impact category (WGFD 2004c).

Of greater concern is the indirect loss of habitat resulting in bird displacement and fragmentation of nesting and early brood-rearing habitat. At eight locations per section impact zones surrounding each well pad, facility and road corridor begin to overlap, thereby reducing habitat effectiveness over much larger, contiguous areas. Human, equipment, and vehicular activity and noise impacts are also more frequent and intensive (WGFD 2004c).

The application of avoidance and mitigation measures would help reduce the loss of habitat and stress to greater sage-grouse in proximity to leks on public lands. Based on research conducted in Wyoming, only 45 percent of nests would be afforded seasonal protection as they are within the 2-mile buffer of leks. Of the suitable nesting habitat, 21 percent is outside the 2-mile buffer and would be afforded no seasonal protection. Habitat loss would continue outside the quarter-mile-protected buffer around leks. However, the long-term loss of shrubs combined with the indirect impacts on the habitat, such as dust, noise, and continued human presence during the drilling and production phase, would result in habitat loss and disturbance levels exceeding the significance criteria (criterion number 4).

Columbian Sharp-Tailed Grouse. The application of avoidance and mitigation measures in this alternative would help to reduce stress to nesting and brood-rearing and wintering sharp-tailed grouse. However, because of the magnitude of habitat loss and continued human presence during the production phase of the project, impacts would exceed the significance criteria (criterion number 4).

Wintering Areas for Grouse. The timing stipulation prevents winter disturbance to greater sage-grouse, but does not prevent the direct loss of wintering areas outside of this time period. Loss of this habitat would lead to lower productivity and long-term decline in the population of these species.

Raptors

With the application of avoidance and mitigation measures, impacts are not expected to exceed the significance criteria.

Fish

Refer to section 4.8 for impacts to sensitive fish species.

4.7.3.3 Alternative A (No Action)

Under Alternative A, drilling would continue for the approved Atlantic Rim pod EAs until they are completed. The remainder of the area would remain undeveloped.

4.7.3.4 Alternative C

Alternative C would proceed with development across the ARPA similar to the Proposed Action alternative, but would be constrained by crucial/sensitive resource concerns. These sites would have additional protective measures beyond what is already provided by applying standard mitigation stipulations (appendix E, appendix H, and appendix L). Examples of these sensitive sites are steep slopes, soils with high runoff potential, big game crucial winter range, and greater sage-grouse nesting and brood-rearing habitat. Because of these sensitive issues, there would be less surface disturbance allowed per section on BLM lands. This would reduce the surface disturbance on lands administered by the BLM by approximately 68 percent relative to the Proposed Action. There would be less than 20 acres of pre-reclamation and 5 acres of post-reclamation surface disturbance with a maximum of four pads per section in grouse nesting and brood-rearing habitat and crucial winter range on BLM lands. This would reduce impacts on different wildlife species to varying degrees.

The overall reduction in acres initially disturbed would reduce habitat fragmentation and indirectly increase potential recruitment of native species re-establishing disturbed sites. This would decrease the overall habitat loss and displacement effects to wildlife species, as well as reduce impediments within movement corridors. A reduction in disturbance of wildlife habitat on BLM lands by 68 percent would benefit all species and reduce the time required, long term, to return the functionality of the habitat in the project area. These benefits would be realized to the greatest extent in the central and southern portions where there is a preponderance of BLM lands. The extreme southern portion and the northern half would realize some benefit of these additional mitigations, but their effectiveness would be reduced due to the lack of equivalent mitigation on private and state lands.

General Wildlife (Species Other than Those Described in Sections below)

Under this alternative, additional mitigation would be applied to minimize impacts to important crucial winter range, important winter habitat for grouse, and greater sage-grouse nesting and brood-rearing habitats. This mitigation to reduce total acres of disturbance would directly and indirectly benefit small birds and mammals. This would reduce disturbance in essential habitats during critical time periods for a diversity of wildlife species. This can include, but is not limited to nesting, brood-rearing, thermal cover and transitional habitat use for a diversity of small birds and mammals. Due to these factors, impacts would not exceed the significance criteria for small mammals and songbirds.

Big Game

Although the exact locations are unknown, at least initially the placement of pads, roads, and other facilities within the ARPA would be focused on areas that are on and adjacent to the existing pods. As build-out occurs from the pods, the unaffected extent of big game crucial winter range acreage would be reduced. Below are the calculations of the percentage of crucial winter range to be impacted (by species of big game) and what percent of the project area would be affected by the additional mitigation. This does not take in to account the impacts to transitional range or migration corridors.

The following acreage figures are for direct habitat loss (conversion of habitat to pads, roads, compressor stations, etc.). There would be less than 20 acres of pre-reclamation and 5 acres of post-reclamation disturbance with the maximum four pads per section (resource roads and pads, not collector roads) on BLM lands within crucial winter range.

Pronghorn Antelope

The pronghorn herd units to be affected by the ARPA are the Bitter Creek and Baggs units. Out of 99,574 acres of crucial winter range habitat found within the Bitter Creek unit, 1,400 acres are located within the ARPA (1 percent). Out of 95,557 acres of crucial winter range habitat found within the Baggs unit, 41,500 acres are located within the ARPA (43 percent). As noted in section 4.7.3.1 (under Big Game), a total of 42,900 acres of pronghorn crucial winter range is located within the ARPA. Twenty-four percent of the crucial winter range is on private and state lands; additional mitigation would not be applied to those lands. Additional mitigation would occur on approximately 12 percent of the ARPA. Reduced acreage of habitat loss within crucial winter range would not help the downward trend in the health of crucial winter range.

Mule Deer

The mule deer herd unit to be affected by the ARPA is the Baggs unit. Out of 270,893 acres of crucial winter range habitat found within the unit, 73,270 acres are located within the ARPA (27 percent). Forty-two percent of the crucial winter range is on private and state lands; additional mitigation would not be applied to those lands. Additional mitigation would occur on approximately 16 percent of the ARPA. Reduced impacts to transition range would help maintain the health of crucial winter range.

Elk

The elk herd units to be affected by the ARPA are the Petition and Sierra Madre units. No crucial winter range for the Petition unit is found within the ARPA. Out of 178,697 acres of crucial winter range habitat found within the Sierra Madre unit, 40,840 acres are located within the ARPA (23 percent). Elk crucial winter range additional mitigation would be applied to approximately 15 percent of the ARPA. Fifteen percent of the crucial winter range is on private and state lands; additional mitigation would not be applied to those lands. Additional mitigation would occur on approximately 10 percent of the ARPA.

Under this alternative, the direct acreage disturbance and number of pads would result in significant impacts to pronghorn and mule deer crucial winter range. For elk crucial winter range, impacts would be reduced to the high category, which would still exceed the significance criteria (criterion number 3).

Upland Game Birds

There would be less than 20 acres of pre-reclamation and 5 acres of post-reclamation with the maximum four pads per section (resource roads and pads, not collector roads) within nesting and brood-rearing habitat.

Greater Sage-Grouse. Ninety-two percent of the project area contains brood-rearing and nesting habitat for greater sage-grouse (BLM-estimated by applying a 2-mile radius buffer around known sage-grouse leks). Direct disturbance would be reduced by 68 percent on public lands, reducing long-term loss of greater sage-grouse habitat to the moderate category. Short-term suspension of grazing use in some pastures would leave more residual grass cover and forbs on grouse habitat, which in turn would benefit those grouse nesting and brood-rearing in

these localized areas. However, the indirect impacts (displacement from construction and drilling noise, traffic, increased human activity) would still exceed the significance criteria (criterion number 4).

Columbian Sharp-Tailed Grouse. Columbian sharp-tailed grouse are found within the southern half of the ARPA. Soil mitigation, restricting surface disturbance on high runoff potential soils, would also indirectly protect nesting and brood-rearing habitat (4,956 acres located in the ARPA). Direct disturbance would be reduced by 68 percent on the 785 acres of nesting and brood-rearing habitat located on BLM lands (16 percent) of nesting and brood-rearing habitat located on BLM lands, reducing direct impacts to the moderate category (section 4.7.3.1, Upland Game Birds, specifically Columbian Sharp-tailed grouse). Disturbance could be the same or greater on the 4,171 acres (84 percent) of nesting and brood-rearing habitat located on private and state land, maintaining impacts in the high category. This combined with other indirect impacts would still exceed the significance criteria (criterion number 4).

Raptors

Under this alternative, impacts would be reduced by minimizing the amount of surface disturbance within sensitive/critical resource areas. With the application of avoidance and mitigation measures, impacts are not expected to exceed the significance criteria.

4.7.3.5 Alternative D

Development would alter or remove approximately 13,600 acres (13,000 new acres and 600 existing acres of disturbance) of wildlife habitat over the next 20 years. At any one time, total unreclaimed disturbance would be capped at 2.8 percent of the entire ARPA or 7,600 acres. Those areas designated as “Category A” would be managed more intensively (utilizing appropriate lease stipulations, conditions of approval, and best management practices) to reduce the extent of surface disturbance below an average of 6.5 acres of disturbance per well constructed. A description of “Category A” areas can be found in section 2.1.4 Alternative D. Reclamation of disturbed habitats would commence immediately after completion of site disturbance activities and continue throughout the 20-year construction period, resulting in a short-term recovery of grass-dominated habitat. Long-term recovery of shrubs to pre-disturbance levels would not occur during the life of the project. On average, there would be 52 acres of pre- and 20 acres of post-reclamation disturbance with the maximum eight pad locations per section.

Impacts are the same as identified in section 4.7.3.1 above, unless discussed below.

General Wildlife (Species Other than Those Described in Sections below)

The long-term disturbance would have a minor effect on wildlife species not dependant upon shrubs. Impacts to songbirds that are dependant upon shrub habitats for nesting and foraging would be significant. The magnitude of habitat loss, and continued human presence during the production phase of the project, would exceed the significance criteria (criterion number 4).

Big Game

Pronghorn Antelope. The acreage disturbance and the actual number of pads per section would fall under a high impact post-reclamation. The direct loss/reduced usability of Wyoming big sagebrush would increase use on remaining shrubs, resulting in continued shrub health

decline outside the immediate project disturbances. This would have the greatest impact to antelope due to their extreme reliance upon sagebrush (96 percent of their diet) during winter. This level of development within pronghorn crucial winter range, compounded by the current condition of the crucial winter habitat, would exceed the significance criteria (criterion number 3).

Mule Deer. The acreage disturbance and the actual number of pads per section would fall under a high impact post-reclamation classification. This level of development within mule deer transitional range and crucial winter range, compounded by the current poor condition of the crucial winter habitat, would exceed the significance criteria (criterion number 3).

Elk. Although actual acreage disturbance would fall under a high impact post-reclamation, there would be an extreme impact to elk based on the actual number of pads (eight pads per section) (WGFD 2004c). With this level of development, impacts to elk crucial winter range would exceed the significance criteria (criterion number 3).

Upland Game Birds

Greater Sage-Grouse. Alternative D habitat disturbances would equate to a maximum direct loss of 8.1 percent of the available nesting habitat (eight locations per section with associated roads and facilities). Under this alternative there is a goal of 20 percent reduction of such habitat disturbance. The extent acreage disturbed by this alternative would place it into the high impact category.

Of greater concern is the indirect loss of habitat resulting from bird displacement and fragmentation of nesting and early brood-rearing habitat. At eight locations per section, impact zones surrounding each well pad, facility, and road corridor begin to overlap, thereby reducing habitat effectiveness over much larger, contiguous areas. Human, equipment, and vehicular activity and noise impacts are also more frequent and intensive at this level of development (WGFD 2004c).

The application of avoidance and mitigation measures would help reduce the loss of habitat and stress to greater sage-grouse in proximity to leks on public lands. Based on research conducted in Wyoming, only 45 percent of nests would be afforded seasonal protection as they are within the 2-mile buffer of leks. Of the suitable nesting habitat, 21 percent is outside the 2-mile buffer and would be afforded no seasonal protection. Habitat loss would continue outside the quarter-mile-protected buffer around leks. However, the long-term loss of shrubs combined with the indirect impacts on the habitat, such as dust, noise, and continued human presence during the drilling and production phase, would result in habitat loss and disturbance levels exceeding the significance criteria (criterion number 4).

Columbian Sharp-Tailed Grouse. The application of avoidance and mitigation measures in this alternative would help to reduce stress to nesting and brood-rearing and wintering sharp-tailed grouse. However, because of the magnitude of habitat loss and continued human presence during the production phase of the project, impacts would exceed the significance criteria (criterion number 4).

Raptors

With the application of avoidance and mitigation measures, impacts are not expected to exceed the significance criteria.

Fish

Refer to section 4.8.3.2 for impacts to sensitive fish species.

4.7.4 Impacts Summary

4.7.4.1 Proposed Action

Standard mitigation measures would indirectly help songbirds during critical time periods; however, impacts on nesting and foraging habitats would be significant. The magnitude of habitat loss, and continued human presence during the production phase of the project, would exceed the significance criteria (criteria numbers 3 and 4).

The impact to small mammals is likely to be minor, and the high reproductive potential of these small mammals would enable populations to quickly repopulate the area following interim reclamation. Most of these species would benefit from an increase in grass-dominated vegetation from reclamation.

This level of development within big game crucial winter and transition ranges, compounded by the current condition of these ranges, would exceed the significance criteria (criterion number 3).

The application of the winter timing stipulation would only protect grouse during this crucial time period. This does not prevent the direct loss of wintering areas for grouse outside of this time period. The long-term loss of shrubs combined with the indirect impacts on the habitat, such as dust, noise, and continued human presence during the drilling and production phases, would result in the proposed action activities exceeding the significance criteria for greater sage-grouse (criterion number 4).

With the application of avoidance and mitigation measures, impacts are not expected to exceed the significance criteria for raptors.

4.7.4.2 Alternative C

Impacts would not exceed the significance criteria for small mammals and songbirds due to these animals' mobility and the additional mitigation measures included under this alternative. These measures would reduce the long term loss of shrubs, the indirect impacts on habitat, such as dust, noise, and continued human presence during the drilling and production phases. This mitigation would directly and indirectly benefit small birds and mammals by reducing disturbance in essential habitats during critical time periods.

Direct and indirect impacts to pronghorn crucial winter range would exceed the significance criteria. Direct impacts to mule deer crucial winter range, combined with indirect impacts, would still exceed the significance criteria. For elk crucial winter range, impacts would be reduced to the high category, which would still exceed the significance criteria (criterion number 3).

Long-term loss of habitat to greater sage-grouse and Columbian sharp-tailed grouse, combined with indirect impacts (See section 4.7.3.1 above) would still exceed the significance criteria (criterion number 4).

With the application of avoidance and mitigation measures, impacts are not expected to exceed the significance criteria for raptors.

4.7.4.3 Alternative D

Standard mitigation measures would indirectly help songbirds during critical time periods; however, impacts on nesting and foraging habitats would be significant. The magnitude of habitat loss, and continued human presence during the production phase of the project, would exceed the significance criteria (criteria numbers 3 and 4).

The impact to small mammals is likely to be minor, and the high reproductive potential of these small mammals would enable populations to quickly repopulate the area following interim reclamation. Most of these species would benefit from an increase in grass-dominated vegetation from reclamation.

This level of development within big game crucial winter and transition range, compounded by the current condition of these ranges, would exceed the significance criteria (criterion number 3).

The application of the winter timing stipulation would only protect grouse during this critical time period. This does not prevent the direct loss of wintering areas for grouse outside of this time period. The long-term loss of shrubs combined with the indirect impacts on the habitat, such as dust, noise, and continued human presence during the drilling and production phases would result in the Proposed Action activities exceeding the significance criteria for greater sage-grouse (criterion number 4).

With the application of avoidance and mitigation measures, impacts are not expected to exceed the significance criteria for raptors.

4.7.5 Additional Mitigation Measures

There are no additional measures proposed for the Proposed Action, Alternatives A and D. For Alternative C, additional mitigation measures are proposed over and above the requirements in appendices E, B, H, and J, and can be found as the development protection measures in appendix L. Alternative D emphasizes reduced disturbance and monitors successful reclamation, putting a limit on disturbance if unreclaimed areas exceed 2.8 percent, or 7,600 acres, of the ARPA. A goal of even further reduced disturbance is placed on Category A (map M-7) areas. Those areas designated as “Category A” would be managed more intensively (utilizing appropriate lease stipulations, conditions of approval, and best management practices) to reduce the extent of surface disturbance below an average of 6.5 acres per well constructed. A description of “Category A” areas can be found in section 2.1.4 Alternative D.

The Proposed Action and Alternative D require that the operators submit annual planning reports to the BLM for their plan of operation for the upcoming year. The BLM will work with the operators at a site-specific level to minimize surface disturbance by applying appropriate lease stipulations, conditions of approval, BMPs and any other measures deemed necessary to minimize surface disturbance and still allow for the maximum economic recovery of natural gas.

4.8 Special Status Plant, Wildlife, and Fish Species

4.8.1 Introduction

The USFWS has determined that nine species, which are listed under the ESA as either threatened, endangered, proposed or candidate species, are potentially present within the BLM RFO management area (USDI-FWS 2004 and table 3-34). In addition, ten species found downstream of the BLM RFO management area in the Platte and Colorado River systems may potentially be impacted if water depletions occur. More detailed information on threatened, endangered, and proposed species is presented in the biological assessment for the Atlantic Rim Project (appendix G). A total of 36 species (7 plants, 6 mammals, 16 birds, 3 amphibians, and 4 fish) occur on the BLM Sensitive Species List in the RFO management area and may occur on or near the ARPA.

4.8.2 Impact Significance Criteria

The Great Divide RMP management objectives for special status wildlife and fish species are the same as presented for wildlife in section 4.7.2. The following criteria were considered in the assessment of impacts associated with the Proposed Action and the alternatives and are the same as those contained in the draft Rawlins RMP (USDI-BLM 2004c). Impacts to species of special concern including threatened, endangered, proposed, candidate, and sensitive species would be considered significant if any of the following was to occur:

1. Substantial loss of habitat function or disruption of life history requirements of a species or population segment that would make them eligible for listing under the ESA.

2. Decreased viability or increased mortality of threatened and endangered, proposed and candidate species, or reduction or alteration of their critical habitats.

3. Management actions that result in substantial disruption or irreplaceable loss of vital and high value habitats, as defined in the WGFD (2004c) Mitigation Policy.

4. Substantial loss of habitat function or disruption of life history requirements of special status species that would preclude improvement of their status.

5. Actions preclude attainment of conservation goals, as stated in conservation plans and strategies for special status species.

4.8.3 Direct and Indirect Impacts

4.8.3.1 Direct and Indirect Impacts Common to All Alternatives

The Wildlife Monitoring and Protection Plan (appendix E) would be followed to prevent, reduce, and detect impacts to threatened, endangered, proposed, and candidate wildlife and fish species throughout the life of the project. The Wildlife Monitoring and Protection Plan serves two purposes. One is to describe the protocols to monitor wildlife responses, habitats, behavioral shifts, etc. The other is to provide protocols to protect wildlife species and track the effectiveness of these protections.

Wildlife habitats directly affected by the proposed project include areas that are physically disturbed by the construction of wells, roads, pipelines, and production facilities. Wildlife habitats indirectly impacted might not be physically disturbed, but the suitability of these habitats is affected by direct disturbances in nearby areas. Disturbance during construction and production phases of development, such as human presence, dust, and noise, may displace or preclude wildlife use of disturbed areas. Wildlife sensitivity to these impacts varies considerably with each animal species.

4.8.3.2 Proposed Action

The following threatened and endangered, proposed, or candidate species are not known to exist in the ARPA and would not be impacted by the project: Blowout penstemon, Colorado butterfly plant, Ute Ladies'-tresses, Canada lynx, Preble's meadow jumping mouse, yellow-billed cuckoo, whooping crane, interior least tern, piping plover, and Eskimo curlew, and Wyoming toad. In addition, there would be no water depletions in the North Platte Drainage so there would be no impacts to the western prairie fringed orchid. Species which may be affected, as well as fish species, are discussed below.

Threatened and Endangered Wildlife Species

Black-Footed Ferret. Development of the Proposed Action would likely result in direct disturbance of some portions of the black-footed ferret's prey, prairie dogs. Surveys for black-footed ferrets would be required before ground disturbing activities within prairie dog colonies located in the Dad Complex. The remaining white-tailed prairie dog colonies within the ARPA are in the "block clearance" area, where surveys for black-footed ferrets are no longer warranted. Implementation of the Proposed Action may affect but is not likely to adversely affect the black-footed ferret.

Bald Eagle. Bald eagles have been observed within the project area primarily during December, January, and February (WGFD 2003a). The majority of bald eagle sightings are in the southern portion of the ARPA close to the Little Snake River. Bald eagles may use the project area for foraging during winter months because a large portion of the project area consists of winter range for antelope, mule deer, and elk.

The potential for vehicle-animal collisions would increase as a result of increased vehicular traffic associated with the project. Because bald eagles commonly feed on carrion, particularly during the winter months, the presence of road-killed wildlife on and adjacent to the access roads is an attractant. Eagles feeding on these carcasses are in danger of being struck by moving vehicles. Any increase in the death rate of bald eagles from vehicular collisions would constitute a significant impact. Because the potential for an increase in wildlife-vehicle-eagle encounters exists, the bald eagle may be affected, but is not likely to be adversely affected.

Threatened and Endangered Fish Species

Four federally endangered fish species may occur as downstream residents of the Colorado River system: Colorado pikeminnow *(Ptychocheilus lucius*), bonytail (*Gila elegans*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*) (USDI-FWS 2003). One federally endangered fish species, the pallid sturgeon (*Scaphirhynchus albus*), may occur as a downstream resident of the Platte River system in Nebraska.

Though they currently exist only downstream of the ARPA, water draining from the ARPA affects the downstream habitat for these species. Under the Upper Colorado River Basin

Endangered Fish Recovery Program "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 that would contribute to the river flow if not intercepted and removed from the system. The BLM retains discretionary authority over individual projects within the project area for the purpose of endangered species consultation. If the recovery program is unable to implement the Recovery Implementation Plant (RIP) in a timely manner or make sufficient progress in recovery of these endangered species, re-initiation of ESA section 7 consultation may be required so that new reasonable and prudent alternatives can be developed. The USFWS 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 (USDI-FWS 1995). The Proposed Action would deplete approximately 10.3 acre-feet of water per year, and thus a mitigation fee waiver would be applicable.

Under the Proposed Action, the primary source of potential risks to these fish species is increases in suspended sediments and sedimentation from land disturbance from project activities. No produced water from the ARPA would be discharged to the Little Snake River drainage; therefore, produced water discharges do not pose a risk to these species. Accidental releases of produced waters or other materials could occur. However, these materials would become highly diluted before they would reach any downstream waters where these species occur; consequently, the potential risks from such occurrences are negligible.

Colorado Pikeminnow, Bonytail, Humpback Chub, and Razorback Sucker. Suitable habitat for these species does not exist on the ARPA. Suitable habitat does exist downstream of the ARPA in the Yampa and Green Rivers; however, the Proposed Action is not expected to affect this habitat provided that mitigation measures for water resources and soils outlined in this document are implemented.

Pallid Sturgeon. Suitable habitat for this species is not available on the ARPA. The pallid sturgeon is present in the Platte River, a tributary to the Missouri River, located downstream from a portion of the ARPA; however, the Proposed Action is not expected to affect this habitat provided that mitigation measures for water resources and soils outlined in this document are implemented.

Sensitive Wildlife Species

The following sensitive species have the potential to occur on the project area; however, the species have not been found within the ARPA. If populations are found, mitigation would be applied to avoid disruption of habitat function or of life history requirements. These species should not be impacted by the project: Nelson's milkvetch, Gibben's beardtongue, pale blue-eyed grass, Cedar Rim thistle, long-eared myotis, fringed myotis, spotted bat, Townsend's big-eared bat, pygmy rabbit, swift fox, trumpeter swan, and the Yellow-billed cuckoo (east of Continental Divide). Species that may be affected are discussed below.

White-Tailed Prairie Dog. There are currently 295 white-tailed prairie dog colonies, covering 6,309 acres, mapped within the ARPA (section 3.8.2.2). The BLM requires that development avoid prairie dog colonies whenever possible. The intensity of development associated with implementation of the Proposed Action would likely result in direct disturbance of some portions of these prairie dog colonies. Direct impacts to prairie dogs, in the form of lost burrows and foraging habitat, would be avoided and are not expected to exceed the impact significance criteria.

Wyoming Pocket Gopher. Based on the known distribution of the species and the availability of suitable habitat, Wyoming pocket-gophers likely occur in the ARPA. If populations are found, mitigation would be developed to protect them. Therefore, impacts are not expected to exceed the impact significance criteria.

White-Faced Ibis. White-faced ibis colonies are always associated with shallow water habitats (Erwin 1983). The Proposed Action is not expected to exceed the significance criteria because development would not occur within 500 feet of riparian and wetland habitats.

Northern Goshawk. In Wyoming, goshawks are found in lodgepole pine and aspen habitat (WGFD 1999). Northern goshawks are known to occur adjacent to the ARPA (WGFD 2003a). Two active goshawk nests were documented outside the eastern edge of the ARPA in the mid to late 1980s in addition to one nest located within the ARPA (See section 3.7.4). With the implementation of mitigation measures for raptor nests (appendix E), implementation of the Proposed Action would not significantly impact the northern goshawk.

Ferruginous Hawk. Ferruginous hawks are known to occur and nest on the ARPA. The primary potential impact to ferruginous hawks from project activities is disturbance during nesting, which could result in reproductive failure. This potential impact would be mitigated by implementing measures in appendix E. Development of the Proposed Action would not significantly impact the ferruginous hawk.

Peregrine Falcon. An available prey base of shorebirds, waterfowl, or small-to-medium-sized terrestrial birds usually occurs within 10 miles of the nest site. Peregrine falcons may migrate through the project area and have been observed on the ARPA (WGFD 2003a), but nesting on or near the project area is unlikely due to the lack of cliffs high enough to provide suitable nesting habitat. If nesting peregrine falcons are found on the ARPA, then all appropriate mitigation measures for raptors would be implemented to prevent or minimize impacts.

Greater Sage-Grouse and Columbian Sharp-tailed Grouse. See section 4.7.3.2.

Mountain Plover. A portion of the potential mountain plover nesting 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. Mountain plover tend to use the same nesting areas from year to year, but the exact nest locations change. Mountain plovers often nest near roads, feed on or near roads, and use roads as travel corridors (USDI-FWS 1999), all of which make the species susceptible to being killed by vehicles. Thus, the operators would be required to inform employees about the potential for roadside and roadway use by this species. The BLM may also identify mountain plover "occupied habitat areas." If these areas were proposed for disturbance, additional mitigation measure(s) would be required to reduce impacts. Given the implementation of mitigation measures in appendix E, mountain plovers are not expected to be significantly impacted.

Long-Billed Curlew. In Wyoming, the long-billed curlew is an uncommon summer resident, but may be locally common in suitable habitat (WGFD 1999). The long-billed curlew is a BLM sensitive species throughout all of Wyoming. There have been three recorded observations of this species approximately 2 miles northeast of the ARPA and one recorded observation in the east-central portion of the ARPA (WGFD 2003a). The long-billed curlew is not expected to nest

on the project area due to lack of habitat, and no significant impacts to this species are expected with implementation of the Proposed Action.

Burrowing Owl. Burrowing owls are known to occur on the ARPA (WGFD 2003a). One active burrowing owl nest was located on the ARPA in 2002. Surveys for this species should be conducted before construction in prairie dog colonies during the owl breeding/nesting season. If nesting owls are found, the same measures used for other raptor species (appendix E) would be applied. Given these precautionary measures, no significant impacts to this species are expected to result from the implementation of the Proposed Action.

Sagebrush-Obligate Song Birds. The sage thrasher, loggerhead shrike, Brewer's sparrow, sage sparrow, and the Baird's sparrow are found in the ARPA (WGFD 2003a). The Proposed Action activities may displace birds to lower quality habitats, which may lead to a reduction in reproduction rates or an increase in predation. The magnitude of direct and indirect habitat loss (section 4.7.3), and continued human presence would exceed the significance criteria (criterion number 4).

Northern Leopard Frog. Sightings have been documented in all counties of Wyoming and this species has a high probability of occurring in areas of the ARPA having perennial water (WYNDD 2003). Provided that measures are taken to avoid disturbance and contamination of perennial water sources (See sections 4.3 and 4.4), no significant impacts to this species are expected from implementation of the Proposed Action.

Sensitive Fish Species

Research conducted during the summer and fall of 2003 and 2004 within the upper Muddy Creek watershed, including the ARPA, found the two most consistent habitat associations among sub-adult and adult roundtail chubs, bluehead suckers, and flannelmouth suckers to be positive associations with both rock substrates and deep pools (as depicted on figures 4-1 and 4-2) (Bower 2005). Under the Proposed Action, the primary impacts to these two habitat features are (1) sedimentation from new construction and project-related land disturbance resulting in decreased availability of rock substrates and (2) alteration of local hydrologic conditions by new road construction that could lead to sedimentation and channel adjustments resulting in a loss of deep pool habitats. In addition, fragmentation of aquatic habitats, if any project-related road crossings of Muddy Creek are constructed, could limit access to required habitats or block fish migration. Though no discharges of produced water to the Little Snake River drainage are planned for the project, because of their limited distribution in Wyoming and range-wide, accidental releases of produced waters or other toxic materials to Muddy Creek would pose a potential risk to sensitive fish populations.

The impact of new roads and other facilities on fish habitats can be divided into three categories: construction, presence, and urbanization (Angermeyer et al. 2004). During the construction phase, before interim reclamation, erosion of soils exposed during earth-moving activities accelerates fine-sediment loading in stream channels. Though the biological effects of sedimentation include a variety of ecological interactions (Waters 1995), sedimentation can act to shift habitat structure such as channel depth, pool-to-riffle ratio, percent fines in substrates, and cover availability (Angermeyer et al. 2004). This sediment can extend miles downstream of the construction site and persist in stream channels for years (Angermeyer et al. 2004).

Figure 4-1. Relative abundance of two length groups of three species within the upper Muddy Creek watershed as a function of the prevalence of rock substrates at the reach scale from Bower (2005). Plots were generated using the averaged multi-model linear-regression function for both length groups of the three species.

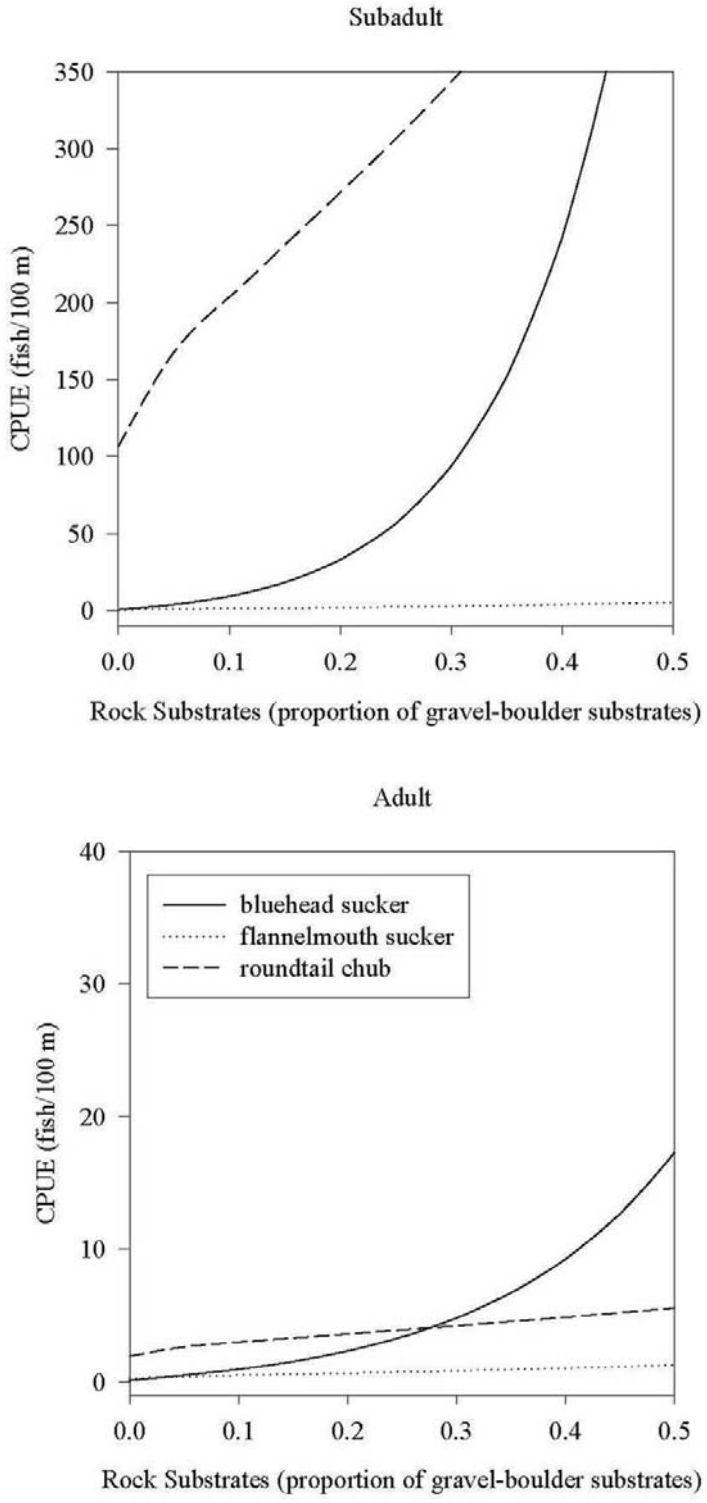
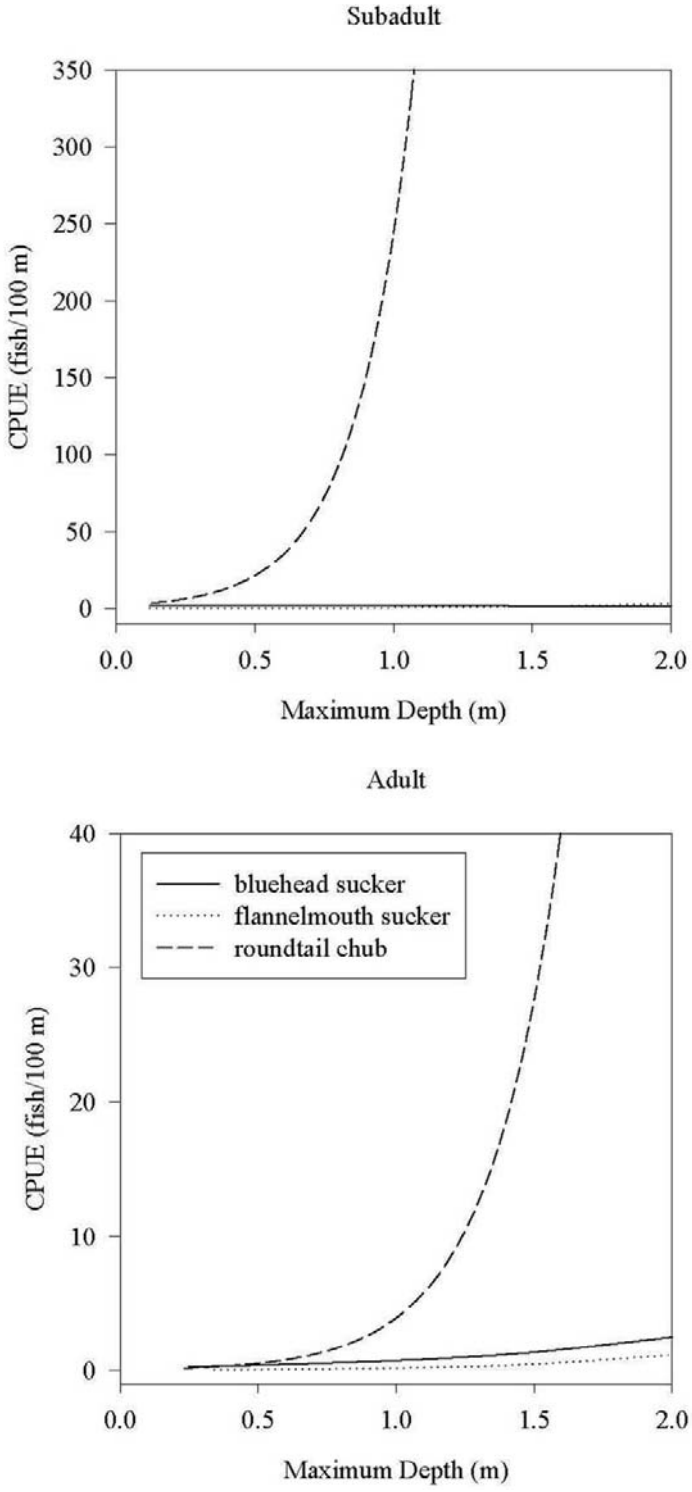


Figure 4-2. Relative abundance of two length groups of three species within the upper Muddy Creek watershed as a function of maximum channel unit depth from Bower (2005). Plots were generated using the averaged multi-model linear-regression function for both length groups of the three species above minimum depth thresholds.



During the presence phase, impacts are primarily associated with the interception of shallow groundwater flow paths by roads. Water is frequently diverted along the roadway and routed to surface water drainage networks at drainage crossings. This can, in turn, alter the timing, routing, and magnitude of runoff, triggering geomorphic adjustments through erosion by channel incision, new gully or channel head formation, or slumping and debris flows (See figure 4-3 and review in Trombulak and Frissel 2000). Channel incision occurs when the base elevation of the stream channel adjusts to account for an alteration of geomorphic parameters, such as sediment supply, flow volume, or channel roughness (e.g., riparian vegetation). Channel incision has been shown to simplify channel geometry and result in the loss of pool habitats (Shields et al. 1994).

Figure 4-3. Example of Erosion Resulting from Concentration of Surface Runoff at Drainage Crossings.

In the case of the Proposed Action, the effects of urbanization can include the detrimental effects of exotic species introductions and increased human presence within the ARPA. Roads provide dispersal mechanisms for a variety of exotic upland and riparian plant species. Of particular concern is the spread of tamarisk (*Tamarix*, also known as salt cedar) within the upper Muddy Creek watershed. This exotic species has been shown to displace native riparian vegetation while consuming a greater volume of water, resulting in reduced water tables and suitability of aquatic habitats (Graf 1978). Tamarisk is currently known to exist in portions of the ARPA and its dispsersal typically occurs via wind and water transport. Increased human uses of the area are also likely to increase the probability of unsanctioned, illegal, and unintentional introductions of exotic fishes and other aquatic organisms. These introductions have been cited as one of the major threats to freshwater biodiversity (Allen and Flecker 1993) and warrant careful consideration given the detrimental effects of exotic fishes on native Colorado River Basin fishes present within the upper Muddy Creek watershed.

Stream fishes require habitats for spawning, feeding, rearing, and refuge. The spatial heterogeneity and connectivity of the stream system can necessitate the movement of fishes among these habitats in order to complete their life cycles (Schlosser 1995). Interruption of movement among required habitats by road crossings can have demographic effects, decreasing population viability (Trombulak and Frissel 2000, Gibson et al. 2005). The distributions of the three target species during the summer and fall of 2003 suggest several potential implications of habitat fragmentation relating to access to refuge habitats and subsequent ability to recolonize adjacent reaches (Bower 2005). In addition, movements of the three species observed during 2005 suggest that required habitats exist in spatially distinct portions of the watershed, thus requiring movement of individuals in order to complete their life history requirements (Compton 2005).

Eighty-acre spacing of coal bed methane well locations under the proposed action would result in a road density of 7.1 miles/mile^2 within the upper Muddy Creek/Grizzly SMA. This includes new road construction (0.5 mile per well location) as well as 100 miles of existing road. In addition, crossings of Muddy Creek are anticipated as a result of the Proposed Action, though the number and specific location of these crossings has not yet been determined.

Research within the Little Robbers Gulch drainage (bordering the ARPA on its western edge) has demonstrated the effects of roads, natural gas drillpads, and pipelines on sediment production and runoff (Wollmer 1994). This work examined the effect of road densities of 2 mile/miles^2 including associated well pad and pipeline facilities on local sediment production and runoff. Wollmer (1994) observed an increase in local sediment production and runoff when compared to unaltered rangeland sites. While this study examined local erosion caused by roads, the study did not address the effects of flow interception which can lead to altered runoff timing, routes, and magnitudes. It is these hydrologic alterations compounded at the drainage scale that are most likely to result in geomorphic adjustments through erosion, causing sedimentation or loss of habitat features such as deep pools.

Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker. The Proposed Action would significantly impact the habitat of these species within the ARPA based on the impacts of new roads and other facilities on the habitat features found to be important to roundtail chubs within the upper Muddy Creek watershed as well as the effects of habitat fragmentation on the ability of roundtail chubs to access required habitats. In addition, the Proposed Action might preclude improvement of their status as prescribed in the Range-wide Conservation Agreement for Bluehead Suckers, Flannelmouth Suckers, and Roundtail Chubs (criterion 4) (UDNR 2004). The EIS contains many best management practices including detailed mitigation measures that will be used following site-specific reviews of the operator's annual planning proposals. The BLM IDT and cooperating agencies will work together to determine the most effective combination of COA's, best management practices and other necessary mitigations to minimize effects from the proposal.

Colorado River Cutthroat Trout. Given the absence of Colorado River cutthroat trout from the ARPA and portions of Muddy Creek downstream of the ARPA, the Proposed Action is not likely to impact the habitat of this species.

4.8.3.3 Alternative A (No Action)

There would be no additional disturbance as a result of this alternative.

4.8.3.4 Alternative C

Wildlife

Alternative C would proceed with development across the ARPA similar to the Proposed Action, but would be constrained by critical/sensitive resource concerns. These sites would have additional protective measures beyond what is already provided by applying standard mitigation stipulations (appendix E, appendix H, appendix L, and BMPs). Examples of some of these sensitive sites are steep slopes, soils with high runoff potential, big game crucial winter range, and greater sage-grouse nesting and brood-rearing habitat. Because of these sensitive issues, there would be less surface disturbance allowed per section on BLM lands. This would reduce the surface disturbance on BLM lands by 68 percent relative to the Proposed Action. There would be less than 20 acres of pre-reclamation and 5 acres of post-reclamation surface disturbance with a maximum of four pads per section in sage-grouse nesting and brood-rearing habitat. The overall reduction in acres initially disturbed would reduce habitat fragmentation and indirectly increase potential recruitment of native species re-establishing disturbed sites. This would decrease the overall habitat loss and displacement effects to wildlife species, as well as reduce impediments within movement corridors. A reduction in disturbance of wildlife habitat on BLM lands by 68 percent would benefit all species and reduce the time required, long term, to return to the functionality of the habitat in the project area. These benefits would be realized to the greatest extent in the central and southern portions where there is a preponderance of BLM lands. The extreme southern portion and the northern half would realize some benefit of these additional mitigations, but their effectiveness would be reduced due to the lack of equivalent mitigation on private and state lands. Soil mitigation, restricting surface disturbance on high runoff potential soils, would also indirectly protect over half of the saltbush steppe habitat within the ARPA. This would benefit species such as white-tailed prairie dog, mountain plover, and burrowing owl. Direct disturbance would be reduced by 68 percent on BLM lands, reducing impacts to all BLM sensitive species. Impacts would not exceed the significance criteria for sagebrush-obligate species under this alternative.

Fish

Development protection measures within the upper Muddy Creek Watershed/Grizzly SMA would benefit sensitive fishes by limiting the alteration of local hydrologic conditions that create and maintain habitat features of importance to sensitive fishes. Two of these habitat features, rock substrates and deep pool habitats, have been shown to be of importance to sensitive fishes (Bower 2005) and are thought to be susceptible to loss or decreased suitability as a result of hydrologic alteration from road construction. Maintenance of existing road densities through the use of existing road paths, as well as incorporation of appropriate road designs (such as low-impact road designs on slopes of less than 8 percent), would result in a net decrease in erosion from the existing road network. Particularly problematic road paths that are causing accelerated erosion would be identified within transportation planning efforts. By reclaiming these problematic road paths, additional road lengths would be available for new road construction when lease holdings could not be accessed along existing paths, without resulting in a net increase in road density or erosion.

Additional special protective measures within the upper Muddy Creek Watershed/Grizzly SMA would preclude the fragmentation of fish habitats by road crossings, thus ensuring that access among the diverse habitats required by sensitive fishes is maintained. These measures would also limit the potential spread of exotic species that often have detrimental direct or indirect impacts on sensitive fishes and their habitats.

Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker. Given the implementation of special protective measures identified for the upper Muddy Creek Watershed/Grizzly SMA, Alternative C would not significantly impact the habitat of these species within the ARPA.

Colorado River Cutthroat Trout. Given the absence of Colorado River cutthroat trout from the ARPA and portions of Muddy Creek downstream of the ARPA, Alternative C is not likely to impact the habitat of this species.

4.8.3.5 Alternative D

Under Alternative D, potential impacts are similar to those described with the Proposed Action (section 4.8.3.1) for the black-footed ferret, bald eagle, Colorado pikeminnow, bonytail, humpback chub, razorback sucker, and pallid sturgeon. Refer to the discussion in the Proposed Action for potential impacts for each species; they are the same for Alternative D. Impacts are also similar for BLM sensitive fish species.

Significant impacts to three sensitive fish species are possible. As described under the Proposed Action, roundtail chub, bluehead suckers, and flannelmouth suckers would be significantly impacted.

4.8.4 Impact Summary

4.8.4.1 Proposed Action

Threatened and Endangered Species

Implementation of the Proposed Action would result in direct loss of habitat from surface disturbance associated with the construction of well sites, related facilities, access roads, and pipelines. In addition, some wildlife species would be indirectly impacted by displacement from habitats in the vicinity of the project area due to the presence of human activities associated with the construction and operation of wells. Small portions of potential black-footed ferret habitat may be disturbed. The potential for collisions between bald eagles and motor vehicles would also increase due to the construction of new roads and increased traffic levels on existing roads. The primary source of potential risks to the fish species is increases in suspended sediments and sedimentation from land disturbance from project activities. The intensity of these impacts may decrease with the completion of the construction phase and with the onset of reclamation efforts on disturbed areas.

None of the threatened and endangered species found downstream of the ARPA within the Colorado River system are known to occur in the ARPA; therefore, there would be no direct impacts to these species. However, water depletion as a result of project development, even though minimal, could indirectly impact these species. Implementation of all mitigation measures for water and soils would help reduce other potential impacts. No produced water from the ARPA would be discharged to the Little Snake River drainage; therefore, produced water discharges do not pose a risk to these species. Accidental releases of produced waters or other materials could occur. However, these materials would become highly diluted before they would reach any downstream waters where these species occur; consequently, the potential risks from such occurrences are negligible. Any water depletion within the Colorado River system results in a “may affect, likely to adversely affect” determination for threatened and endangered species found in and along this river. Therefore, BLM would initiate formal consultation with USFWS for those species. If any threatened or endangered fish species are

identified within the ARPA, the BLM would consult with the USFWS and develop a protection plan for the fish.

Sensitive Species

With the implementation of the Proposed Action, direct loss of habitat would result from surface disturbance associated with the construction of well sites and related access roads and pipelines. Small portions of potential habitat for several sensitive species may be disturbed. The intensity of these impacts would decrease with the completion of the construction phase and with the onset of reclamation efforts on many of the disturbed areas. The application of prescribed avoidance, monitoring (Wildlife Monitoring and Protection Plan, appendix E) and mitigation measures (appendix H) would reduce the impact potential. Impacts would still exceed the significance criteria for sagebrush-obligate species. Alteration of fish habitat suitability would result in significant impacts to sensitive fishes (criterion number 4).

4.8.4.2 Alternative C

Overall impacts to special status species would be very similar to the Proposed Action. Direct disturbance on BLM lands would be reduced by 68 percent reducing potential impacts to all special status species. Impacts would not exceed the significance criteria for sagebrush obligate species under this alternative. Development protection measures applied to the upper Muddy Creek Watershed/Grizzly SMA would help to maintain the suitability of habitats for sensitive fishes.

4.8.4.3 Alternative D

Overall impacts to special status species would be the same as those described under the Proposed Action. There is some potential for reduction of impacts due to the acreage limitation for disturbed and unreclaimed areas. In addition the disturbance reduction goal (approximately 20 percent) may result in reduced impacts due to reduced initial disturbance. Because the overall number of wells through the life of the project is unchanged, those species significantly impacted under the Proposed Action will remain so under Alternative D (criterion number 4).

4.8.5 Additional Mitigation Measures

There are no additional mitigation measures identified for threatened and endangered species or BLM sensitive species unless identified mountain-plover-occupied habitat areas are proposed to be disturbed. If this happens, the following additional mitigation measures are advised:

- Surface disturbance would occur outside identified occupied habitat for mountain plovers where feasible.

- Within a half-mile of the identified mountain-plover-occupied habitat area, speed limits would be posted at 25 mph on resource roads and 35 mph on local roads during the brood-rearing period (June 1–July 10). BLM anticipates that enforcement of speed limits will occur by the companies advising and disciplining their employees and contractors as necessary to comply with speed limits.

- Access roads would be realigned to avoid the identified mountain–plover-occupied habitat area.

- To protect mountain plover in occupied habitat, traffic would be minimized from June 1–July 10 by car-pooling and organizing work activities to minimize trips on roads through the mountain-plover-occupied habitat area.

- To protect mountain plover in occupied habitat, fences, storage tanks, and other elevated structures would be either constructed as low as possible or would incorporate perch-inhibitors into their design.

- To minimize destruction of nests and disturbance to breeding mountain plovers, no ground-disturbing activities would occur from April 10–July 10 unless surveys consistent with the Plover Guidelines or other USFWS-approved method find that no plovers are nesting in the area.

- A plugged and abandoned well within a half mile of the identified mountain-plover-occupied habitat area would be identified with a marker 4 feet tall with a perch inhibitor on the top of the marker.

4.9 Recreation Resources

4.9.1 Introduction

This section addresses the potential impacts of the Proposed Action and alternatives to recreational resources in the ARPA. The analysis focuses on the principal form of recreation within the ARPA, which is big game hunting, and considers both direct and indirect impacts to recreation resources.

The ARPA contains no developed recreation sites. OHV use is limited to existing roads and two-tracks, except for retrieving downed game animals or accessing primitive campsites. These exceptions do allow the creation of new two-tracks which can further fragment habitat, cause erosion and sedimentation, and reduce vegetative cover. Dispersed recreation in the ARPA occurs primarily on BLM land and consists largely of hunting by residents and visitors from outside the region. Camping and OHV use within the ARPA occur most often in conjunction with hunting. There is some seasonal pleasure driving and snow machine use, which often incorporate wildlife viewing as a significant reason for visiting the area.

The ARPA contains two ACECs—Sand Hills ACEC and Jep Canyon ACEC—which merit intensive management of surface-disturbing activities for wildlife habitat (USDI-BLM 1990 and 2003b).

The health and abundance of wildlife populations directly affect the quality of hunting in the ARPA. When wildlife populations fluctuate, so do wildlife-based recreational opportunities. To determine impacts to hunting, the recreation analysis relies on the analysis of impacts to big game wildlife in the ARPA (section 4.7). The narrative and maps (M-21 through M-29) presented in section 3.7 were evaluated for their potential effect on hunting because of a loss of carrying capacity or the displacement of game.

Impacts to visual resources in the ARPA, identified in section 4.10, also were considered for effects on recreation. Visual resources influence the character of outdoor opportunities by affecting the recreation setting, as do other effects of gas development such as noise, dust, and traffic on recreational access routes.

4.9.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with recreation resources:

- To ensure the continued availability of outdoor recreational opportunities, to meet legal requirements for the health and safety of visitors, and to mitigate conflicts with other resource uses.

The main concern for the recreation analysis is displacement of existing recreational use by the Proposed Action and alternatives. Impacts to recreation would be significant if:

1. An action would cause displacement of hunting, wildlife viewing, and driving for pleasure from the ARPA when no other comparable area nearby could reasonably provide substitute opportunities.

4.9.3 Direct and Indirect Impacts

The Proposed Action and alternatives would potentially have both direct and indirect impacts to recreation. Direct impacts to recreation resources occur because of the physical disturbance and removal of vegetation from the construction of facilities; the visual impacts of facilities and activities; and from the noise, traffic, and visual distraction of human activity.

Examples of direct impacts include the removal of wildlife habitat that may affect game populations and the intrusion of gas facilities on a natural-appearing landscape. Indirect effects to recreation resources include changes to recreation use and experiences on lands near directly impacted recreation resources. Examples are disturbances of nearby recreation settings by traffic, noise, and landscape changes associated with gas facilities and related activity that would intensify visitation at other undeveloped areas nearby.

Most effects to recreation from the Proposed Action and alternatives would tend to decrease in the quality of recreation opportunities and the appeal of the setting for most recreationists. New roads associated with development may be considered useful in that they provide increased access for activities such as hunting, but roads fragment wildlife habitat and the associated increase in development activity would displace wildlife. Two-tracks that are lightly traveled during hunting season do not interfere with, and may be conducive to successful hunts, whereas industrial traffic on improved roads is not. Hence new improved roads do not benefit hunting. As development of the project progresses and game is displaced, success rates would be expected to decline along with the size of the herd remaining in the project area. The opportunity to pursue game on foot is diminished when an abundance of roads provide access to road hunters that could scare game from the area.

Indirect impacts to recreation can occur from population growth associated with the project's workforce. This factor was considered but not pursued further in the analysis of the Proposed Action and alternatives because the project is unlikely to cause significant long-term population effects, as described in section 4.12. Impacts to recreation from potential residential development in the future are also described in chapter 5.

The principal recreation impact likely to be associated with the Proposed Action and alternatives is the change in big game hunting opportunities because of habitat loss and wildlife

displacement. The underlying effects upon wildlife habitat and behavior were analyzed in section 4.7. Changes to the landscape, analyzed in section 4.10, also would affect hunters who value a natural setting as part of their experience and pleasure drivers who visit the ARPA to view the scenery and watch wildlife. These impacts would occur as the direct and indirect results of a higher density and wider distribution of gas development within the ARPA compared to existing conditions.

4.9.3.1 Proposed Action

As described in detail in chapter 2, a total of 2,000 new natural gas wells would be drilled and developed under this alternative during the next 20 years with an expected life of project of 30–50 years. Well placement within the ARPA is not known at this time, but it is assumed that development would likely be concentrated within or near existing pods, although some wells would also be drilled in outlying areas where development currently does not exist.

Impacts to Hunting

The big game species potentially affected by the Proposed Action are mule deer, elk, and pronghorn antelope. The proposed level of development would disturb approximately 15,800 acres of wildlife habitat over 20 years, but interim reclamation, as intended by the operator (appendices B and K), would reduce long-term disturbance and direct loss of habitat to a total of 6,200 acres.

In addition to the direct loss of habitat due to construction of well pads and associated roads, pipelines and utilities, disturbance from human activity and traffic would lower the use of habitat immediately adjacent to developed areas and cause wildlife displacement from an area larger than the actual disturbed sites. As noted in section 4.7.3.1, this displacement effect has the potential to result in local reductions in wildlife. As also noted in section 4.7.3.1, despite acclimation and re-occupation, the increased human footprint over all on a previously lightly developed area is detrimental to big game species populations if adjacent, undisturbed habitats are at carrying capacity.

The extent of wildlife displacement is impossible to predict. Impacts to hunting would occur in the ARPA proportional to the displacement of big game in connection with the Proposed Action. If hunter success rates declined, use of the hunt areas would be likely to decline as well. The impact would be borne primarily by local and regional hunters, especially local hunters for whom the benefits of the ARPA would be diminished as a convenient and economical place to hunt. The impact would also be borne by commercial outfitters permitted to use the ARPA (See table 3-42). Increased development in the ARPA—with its potential to displace big game and its effect on the recreation setting—would reduce the appeal of the project area for a commercial clientele whose values include a successful harvest in an attractive recreational setting.

Impacts to the Recreation Setting

For many hunters and other outdoor recreationists, a natural setting is critical to the quality of the recreation experience. In the ARPA, the Proposed Action and action alternatives would potentially affect the recreation setting due to traffic, dust and noise and by impacting visual resources.

As section 4.10 concludes, the Proposed Action and action alternatives would have a high, impact on the natural appearance of the landscape. This level of degradation of the scenery would potentially affect hunters and other recreation visitors to the ARPA.

Research has found that hunters participate in this activity for many reasons. Though hunting success is the predominant reason, enjoyment of the outdoors and the environment has a key role for many hunters (Manning 1986). Therefore, the visual quality of the setting would likely be important to many hunters in the ARPA, and degradation of the scenery in the project area would diminish their enjoyment and the satisfaction of the hunt.

For pleasure drivers and wildlife viewers, natural scenery and productive wildlife habitats are an essential part of the recreational setting. These recreational visitors would likely be very sensitive to changes in visual quality, and impacts to visual quality in the project area would likely diminish their enjoyment of the outdoor experience.

For hunters, wildlife viewers, and pleasure drivers, industrial traffic on roads in the ARPA would potentially detract from the recreational character of the setting in the ARPA. The operator is committed to posting appropriate warning signs, implementing safety training for the operators of project vehicles and equipment, and requiring project vehicles to adhere to low speed limits (See appendix K). These project management practices would potentially limit conflicts between project activity and recreation use in the ARPA. However, some level of conflict with the expectations of recreationists is unavoidable, particularly during drilling and field development activities. The risk of traffic accidents is significantly increased by vehicles associated with development and production in the ARPA.

Noise levels associated with drilling, field development, and operations activities may temporarily exceed threshold EPA average noise levels at specific locations within the ARPA, as noted in section 4.15. This would directly detract from the relative silence of undisturbed country customarily sought by recreational visitors engaged in hunting, wildlife observation, and sightseeing. Noise impacts due to drilling, field development, and traffic may be unavoidable, at least during the drilling and development phases, after which much of the noise would abate. However, noise associated with compression and individual well pumps would be long term in duration and would potentially displace recreation to other areas.

Impacts to hydrologic systems and soil-stabilizing vegetation would impact the recreation experience by altering the undeveloped setting present in most of the ARPA. The proliferation of opportunistic weeds on disturbed soils would further alter the setting and inhibit the success of reclamation.

The duration of the effects would be for the life of the project—which may affect more than one generation of recreation user—but the intensity of the effects would be lower after drilling and construction ends. The Proposed Action would likely displace some dispersed recreation use from the ARPA to areas for hunting and wildlife viewing that are farther away and are themselves likely to be under increasing pressure for development.

As noted in chapter 3, there are no recreational visitation counts for the ARPA, but overall use is believed to be low, except during and just prior to hunting season, which occurs primarily in the fall (USDI-BLM 2000a). Low visitation during the rest of the year is due to low population densities in proximity to the area and the historically seasonal nature of the road network. Snowdrifts in winter and any rains the rest of the year have, in the past, made most of the roads intermittently impassable.

Visitation to the ARPA may increase in the future because of recent improvements in surfacing on BLM and county roads. New roads developed in the ARPA to support gas development may

also encourage use by opening access to new areas. With increased use over time, the impact of the Proposed Action may be higher. Another factor expected to promote visitation to the area is the stabilization and interpretation of the JO Ranch that was recently acquired by BLM near the Sand Hills. The Continental Divide National Scenic Trail is not likely to notably increase visitation to the project area, despite its being within 3 miles of the northeastern boundary of the ARPA.

In conclusion, the impacts to the predominant recreation activities in the ARPA—hunting, pleasure driving, and wildlife viewing—would be significant. The Proposed Action would diminish the wildlife presence, degrade scenery, and introduce traffic and noise. The natural setting would be converted to an industrialized setting by development of the Proposed Action. These effects would likely make recreating in the project area significantly less desirable.

4.9.3.2 Alternative A (No Action)

Under the no action alternative, the Proposed Action would not be approved. The ARPA's recreation experience would continue to be affected by existing facilities and interim drilling, but no new impacts to recreation and hunting would be introduced by the no action alternative.

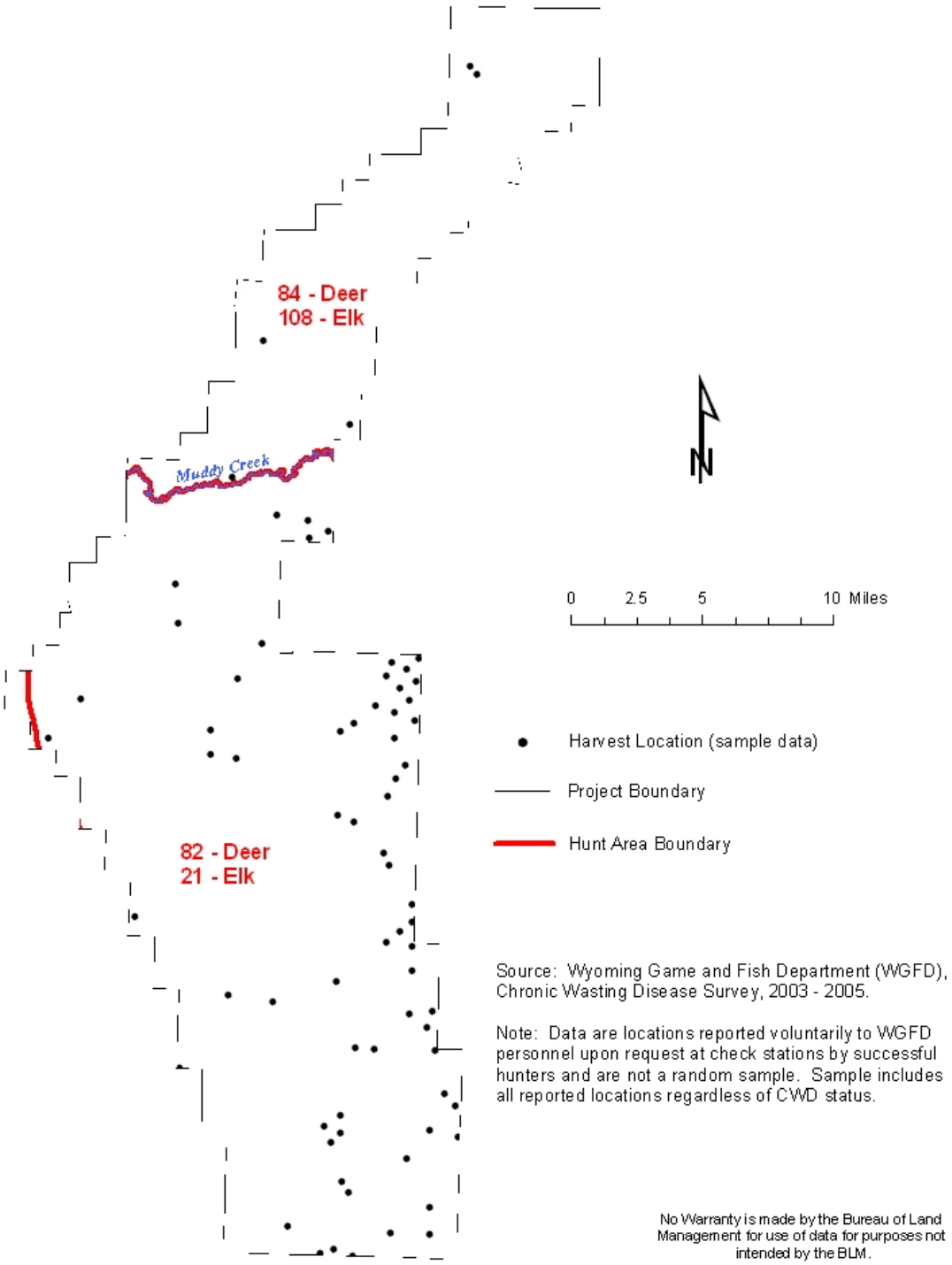
4.9.3.3 Alternative C

Some of the development protection measures included in Alternative C would reduce impacts to recreation. The following limitations on surface disturbance would help retain the existing quality of recreation opportunities in the ARPA: in slopes over 8 percent, vegetation communities with high wildlife values, rare vegetation communities, proximity to water or wetlands, big game crucial winter range, grouse brood-rearing and nesting habitat, silver sagebrush/bitterbrush communities, and soils with high runoff potential. The following would also contribute to preservation of the recreational setting: road density limitations for grouse brood-rearing and nesting habitat and some SMAs along with requirements for prompt interim reclamation; low impact road designs; careful siting of well pads, roads, and facilities; and dust abatement techniques.

Data from the WGFD random surveys were used to identify the areas of concentration of deer and elk hunter success in the ARPA. These areas are illustrated on map M-41. As this figure shows, the hunter success is concentrated in five general areas, all of which fall within the boundaries of WGFD Hunt Area 82, one of the most heavily hunted areas in the state. The areas are generally known as the Sand Hills, Deep Gulch and Cow Creek, Wild Cow Creek, Cherokee Creek, and Wild Horse Creek. Development in or adjacent to these areas would be expected to displace big game, and thus big game hunting to other areas where development is not occurring.

Direct loss of habitat due to construction of well pads and associated roads and pipelines would lead to some wildlife displacement in these areas. Displacement due to habitat loss can be minimized but not avoided. This type of displacement would have impacts to hunting in the ARPA and would be disproportionate because of the importance of these areas to game herds and thus to hunting.

Map M-41. Locations of Successful Hunts.



A second type of impact, the disturbance of individual game animals by human activity and traffic would have affects on hunting. The long-term displacement of game herds because of sustained activity and noise is addressed in section 4.7. Very short-term displacement of individual animals or small groups would also occur as an immediate, direct response to traffic, noise, and human activity. This type of disturbance, which can cause game to avoid an area for the better part of a day or so, is disruptive to hunting. Repeated disturbance of this kind could have an impact on the quality of an entire hunting season.

Because hunter success in the ARPA is concentrated in the areas described above, short-term disturbance of game by project activity occurring during hunting season would potentially have a disproportionate impact by reducing hunter success and the hunting experience. The impact to the areas of concentrated hunter success would potentially reflect on a reduced quality hunting experience in affected parts of the ARPA and, perhaps, in the game management unit as a whole.

The Cow Butte/Wild Cow and Sand Hills SMAs include some of the most heavily hunted portions of the ARPA. Development protection measures for these SMAs would include limitations to surface disturbance and road densities, and fence conversions to BLM standards for improved wildlife passage. These and other development protection measures particular to each SMA would help retain the quality of hunting, wildlife viewing, and recreation experiences in the ARPA.

The potential for up to a 68-percent reduction in surface disturbance and other development protection measures associated with Alternative C would reduce the project's impacts on recreation, but the overall network of facilities associated with 2,000 wells would still have a significant impact on recreation in the ARPA by displacing wildlife, and therefore hunters, wildlife viewers, and other recreationists.

4.9.3.4 Alternative D

Impacts to hunting and to the recreation setting under Alternative D would be similar to, but of a lesser magnitude than the impacts described under the Proposed Action (section 4.9.3.1 above). The acreage of the project area that would be disturbed at any one time under Alternative D (goal of 6.5 acres average disturbance per well site) would be approximately 20 percent less than the acreage anticipated under the Proposed Action (7.9 acres per well site). The pace of development analyzed under Alternative D is the same as for the Proposed Action.

Impacts to recreation in Category A areas would be less than in the Proposed Action due to the reduced surface disturbance and more careful mitigations, which would reduce visual impacts and loss of vegetation. Recreationists and wildlife would still be displaced by the equipment, human activity, noise, dust and industrial traffic during the development phase of the project. During the operation phase, visual impacts would remain, as would some human activity, habitat fragmentation, and the noise associated with working facilities, so even these areas would remain undesirable places to recreate until after final reclamation.

The impacts to hunting and to the recreation setting are similar under both the Proposed Action and Alternative D because reclamation success would not necessarily reduce the amount of disturbance in the short and long term under both alternatives even though the analyses of both alternatives assumed that operators' reclamation efforts would be successful.

4.9.4 Additional Mitigation Measures

The recreation analysis assumes the implementation of mitigations adopted as a result of the analysis of impacts to recreation, wildlife resources, and visual resources. There are no relevant operator-committed mitigation measures. The operator may choose to include mitigations for habitat enhancements in nearby undeveloped areas to compensate for degradation of habitat in the ARPA; other measures, as discussed in section 4.7; and BMPs applied at the annual planning level. Minimizing activity during hunting season would not be an effective mitigation due to the disturbance of wildlife that normally occurs as a part of hunting activities.

No additional mitigation measures are necessary to specifically address impacts to recreation resources.

4.10 Visual Resources

4.10.1 Introduction

The landscape within the ARPA contains broad areas of grasslands, sagebrush, and tree cover, with the type of vegetative cover depending on variables, such as soils, aspect, elevation of the surface, and water availability. Existing disturbance from oil and gas development is about 600 acres. This disturbance—about 0.2 percent of the 270,080 total acres in the ARPA—comprises unreclaimed areas from prior development of well pads, compressor stations, and containment ponds. A small portion of the remainder of the ARPA has been modified by improved and unimproved roads, power lines, constructed ponds, and irrigated cropland.

The issues of concern for visual resources in the ARPA are (1) whether changes to the landscape from gas development would exceed BLM visual resource management objectives and (2) whether changes in the visual resources due to gas development would potentially affect other users of the ARPA. The objective of VRM Management Class III is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but ***should not dominate the view of the casual observer***. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

The classification of ARPA lands by visual quality, as defined by the BLM in the RMP, was determined according to the visual resource inventory procedure that is prescribed in BLM's Visual Resource Inventory Manual 8410 (USDI-BLM 1980). The BLM's visual resource considerations during the siting of oil and gas facilities seek to minimize impacts to the extent possible and to avoid impacts that exceed allowable thresholds under existing VRM classifications. During the siting of specific oil and gas facilities within the ARPA, opportunities will be sought to minimize the prominence of structures, minimize unavoidable open disturbance during operations, and align roads and other ROWs for reduced visibility and contrast with natural features.

The analysis assumes that measures presented in the Reclamation Plan (appendix B) would be implemented. Because of the large geographic area covered by the project and the fact that the specific location of project facilities is unknown at this time, the reclamation measures were presented in the plan in a general, non-specific manner. The final choice of measures to be applied at any given location would be identified by the BLM in coordination with the operators.

In the Great Divide RMP, BLM classified 259,000 acres of the 270,000 acres in the ARPA (about 96 percent) as VRM Class III, placing it in the category that comprises about 75 percent of all land in Great Divide Resource Area. The rest of the land in the ARPA, located in the vicinity of Dad, is classified as VRM Class IV.

The management objective for VRM Class III is to allow only a moderate level of contrast between project features and the existing landscape. Moderate contrast means that project features should be selected, located, and designed so as to not become dominant in the landscape, though they may be evident to the viewer and may even attract the viewer's attention. VRM Class IV allows a strong visual contrast with the landscape, meaning project features may dominate views and even be the focus of viewer attention, though even in Class IV BLM may encourage the use of topography and vegetation to screen project features and reduce visual contrast.

4.10.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objective associated with visual resources:

1. To minimize effects on visual resources while maintaining the effectiveness of land-use allocations.

Visual impacts are considered significant if an activity or development in an area:

1. Is incompatible with the designated VRM class objective,
2. Becomes an unacceptable feature of the landscape or visual horizon, and
3. Has a "High" predicted visual contrast, as detailed in table 4-8.

Table 4-8. Criteria for Assigning Summary Assessment of Impacts to Visual Resources for the Development Alternatives.

Level of Impact	Criteria
High	Predicted visual contrast would be higher than the level of change to the characteristic landscape allowable by the visual resource management (VRM) classification. For example, introduced facilities in VRM Class III that dominate the landscape by becoming the primary focus of and holding viewers' attention would be rated as a high impact.
Moderate	Predicted visual contrast would be equal to but not exceed the level of change to the characteristic landscape allowable by the VRM classification. For example, introduced facilities in VRM Class III that are evident in the landscape and attract attention without dominating the view of the casual observer would be rated as moderate impact.
Low	Predicted visual contrast would be lower than the level of change allowable by the VRM classification. For example, introduced facilities in VRM Class III that are evident to viewers but otherwise conform to the landscape's natural lines, forms, colors, and textures would be rated as a low impact.

In determining the level of visual contrast to be expected from the alternatives, this analysis has followed guidance on visual contrast rating from the BLM Visual Contrast Rating Manual H-8431-1 (USDI-BLM 1999). The degree to which a management activity affects the

visual quality of a landscape depends on the visual contrast created by the project and the existing landscape. Briefly, the visual contrast introduced to the landscape by features of the proposed project is rated as weak, moderate, or strong based on a comparison of the development's form, line, color, and texture to the same elements in the characteristic landscape.

To arrive at an impact rating, the analysis compares the highest visual contrast that the project would cause with the management objective for VRM Class III, which, as noted, comprises 96 percent of the ARPA. The impact rating to be attributed to the alternatives are assessed by applying criteria from table 4-8.

The VRM objectives for the ARPA were established by the RMP through the classification of all field office lands. The classifications are the sole determinant of the allowable level of visual impact. However, the RMP also includes guidance for management decisions in a multiple use context, such as where visual and mineral resources co-exist. The RMP includes an overall objective for visual resource management in the resource area as a whole that calls for minimizing the impacts to visual resources while maintaining the effectiveness of land-use allocations for activities based on other resources (USDI-BLM 1990). Similarly, the overall objective stated in the RMP for oil and gas resource management throughout the resource area calls for providing opportunities for development of mineral resources while protecting other resource values (USDI-BLM 1990).

The task of effects on visual resources while maintaining the effectiveness of land-use allocations is undertaken by BLM as a part of site-specific analyses of specific project proposals. These analyses are required once a site-specific proposal and additional resource information have been submitted to the BLM for approval. The site-specific analyses would occur after issuance of the ROD by BLM and before surface disturbance pursuant to an individual APD or ROW grant would be allowed to take place on federal surface or minerals.

The ARPA is a large area and the alternatives are general in describing how project features would be located within the ARPA. This analysis proceeds by considering the level of visual contrast that would result from seeing typical project features from selected roads within the ARPA. The selected roads considered by the analysis are the maintained roads that access the principal areas within the ARPA where gas development would occur and where other uses, such as recreation, occur as well.

4.10.3 Direct and Indirect Impacts

4.10.3.1 Proposed Action

Features of the Proposed Action that would impact visual resources include structures (wellheads, tanks, generators, compressor units, etc.), structure sites (reclaimed to production size), roads with adjacent utility ROWs (reclaimed to the life-of-project travel surface), and unreclaimed surface areas. To mitigate visual impacts, facilities would be painted Shale Green or Brush Brown (or other non-reflective color approved by the BLM), sites would be cleaned up, and interim reclamation activities initiated. In general, interim reclamation would occur concurrently as sections of the project are completed. Revegetation realized through successful interim reclamation would potentially create continued contrast with the existing landscape throughout the life of the project. The period of time that this contrast would exist would be

variable, since it depends on the success of the reclamation measures and on the time needed for primary succession to return disturbed areas to pre-disturbance vegetation conditions.

The Proposed Action would potentially increase the amount of oil-and-gas-related disturbance in the ARPA approximately ten fold from current impacts from the Atlantic Rim pods. This would increase the likelihood of seeing a landscape in the ARPA that includes oil and gas structures, the bare soil of well pads, and other facility sites and roads. The appearance of gas development at 80-acre spacing would create unavoidable contrast with natural landscapes in the ARPA, especially in tracts of continuous vegetation. The highly contrasting and difficult-to-conceal elements of development that appear with greater frequency at the proposed density are the bare pads where well and other facilities are constructed and the network of access and service roads.

The greatest potential for seeing visual contrasts from the Proposed Action would be from the principal roads of the ARPA. These roads would likely be traveled by private property owners and recreationists, as well as by ranch and oil-and-gas-related personnel. Sensitivity to the level of visual contrast from oil and gas development would likely be highest among recreationists, who include hunters, sightseers, and wildlife observers.

Table 4-9 lists roads where users would potentially see foreground/middle ground views of oil and gas structures and related change. These are views where contrasting features would be less than 3 miles from the viewer, according to the Visual Resource Inventory Manual H-8410-1 definitions of distance zones for visual resources analysis. The roads in table 4-9 either access the northern or the southern part of the ARPA.

Approximately 65 percent of the VRM Class III lands in the ARPA are visible from one or more of the state, county or BLM roads in or adjacent to the project area (map M-6). Approximately 67 percent of the Class III federal lands are visible. Therefore seeing development with strong contrast to the natural landscape that dominates the view of sensitive observers is quite probable and most likely unavoidable under the Proposed Action.

Users of CCR 503 and 608, as well as BLM 3309, would also occasionally see panoramic views with the facilities, roads, and reclaimed areas of the Proposed Action in the background.

Table 4-9. Roads in the ARPA Where Users Would Likely See Views of Oil and Gas Facilities under the Proposed Action.

Northern Part of ARPA		Southern Part of ARPA	
Number	**Common Name**	**Number**	**Common Name**
CCR 605	Twenty Mile Road Daley Road	CR 503 CR 608 (west end) CR 608 (east end) BLM 3305 BLM 3308 BLM 3309 BLM 3320	Dixon Road Dad Road Lone Butte Road Willows Road Cow Butte Road Wild Horse Road Muddy Mountain Road

Notes:
CCR – Carbon County Road
CR – County Road
All roads would likely access foreground to middle ground views of facilities within 3 to 5 miles or less of the viewer.
The northern part of ARPA includes the Red Rim and Jolly Roger federal lease units.
The southern part of ARPA includes the Doty Mountain, Cow Creek, Sun Dog, Blue Sky, Brown Cow, Boulder Creek, and Burbank Draw federal lease units.

Some portions of the roads identified in table 4-9 already have views of wells developed in the interim drilling period. As these views indicate, gas development does contrast with the characteristic landscape, even when designed and sited specifically for the ARPA. Judging from these examples, the greatest level of visual contrast due to the Proposed Action would occur because of bare soils on well pads, production facilities and structures, and associated roads. Specifically, geometric lines associated with these activities would contrast strongly with the characteristic vegetation and topography of the ARPA.

The reclaimed surface disturbance introduced by the Proposed Action would contrast with the ARPA landscape to a lesser degree. Reclaimed areas would contrast with undisturbed cover for several years because vegetation is slow to recover in most of the ARPA. While the VRM Class III rating allows for development so long as it does not dominate the view of the casual observer, 80 acre spacing would clearly create visual impacts that would dominate the view unless the development was very well mitigated. Hunters, sightseers, and wildlife observers would likely be sensitive to the visual impacts of development because the visual quality of the setting is integral to the quality of the recreation experience. Livestock operators and oil and gas development personnel, who by definition are not casual observers, would also see the visual impacts in the ARPA, although they would likely be less sensitive to these impacts because they would be working in the area, not there to enjoy it.

Impacts to hydrologic systems and loss of vegetation would alter the character of the visual setting present in the ARPA. The proliferation of weeds on disturbed soils would further alter the setting and inhibit the success of reclamation.

In conclusion, the visual contrast introduced into the ARPA by the Proposed Action would be high. This level of contrast exceeds the maximum allowable in VRM Class III (96 percent of the ARPA) and is allowable in VRM Class IV (only 4 percent of the ARPA). Therefore, based on the criteria presented in table 4-8, the impact of the Proposed Action as a whole to visual resources of the ARPA would be high, and thus significant. Impacts to visual resources from the Proposed Action would be long term, beginning during development and lasting beyond the life of the project. In addition, the Proposed Action would potentially leave weak residual impacts in place

on the landscape even after final reclamation at the end of the life of the project because of the time it takes for reclaimed areas to return to pre-disturbance vegetative conditions.

4.10.3.2 Alternative A (No Action)

Under this no action alternative, the Proposed Action would not be approved. The ARPA's visual character would continue to be affected by existing facilities, but no new visual impacts would be introduced, nor would management objectives for VRM Class III be exceeded. The level of contrast introduced by the no action alternative would be low, therefore not significant.

4.10.3.3 Alternative C

Some of the development protection measures included in Alternative C, such as limitations on surface disturbance in slopes over 8 percent, vegetation communities with high wildlife values, rare vegetation communities, proximity to water or wetlands, big game crucial winter range, grouse brood-rearing and nesting habitat, silver sagebrush/bitterbrush communities, and soils with high runoff potential would reduce the visual impacts of development. Road density limitations for grouse brood-rearing and nesting habitat and some SMAs along with requirements for prompt interim reclamation, low impact road designs, careful siting of well pads, roads and facilities, and dust abatement techniques would also contribute to the preservation of the visual setting (See appendix L).

As noted in the introduction and in section 4.10.2, impacts to visual resources in the ARPA were determined by assessing the visual contrast that the project would create on the landscape of the VRM Class III rated lands which constitute 96 percent of the ARPA. 67 percent of the federal lands in the ARPA are visible from federal, state or county roads. Therefore seeing development with strong contrast to the natural landscape that dominates the view of sensitive observers is quite probable and most likely unavoidable.

Development protection measures for visual resources under Alternative C would further reduce the visual impact of the project. Low impact road designs would be used in visible VRM Class III areas with less than 5 percent slope (map M-42), which comprise over 26 percent of the federal surface in the ARPA. Other measures to reduce surface disturbance, prevent facility intrusion above the skyline, do reclamation promptly, and maximize pad distance from main roads would also contribute to preservation of the visual character of the area.

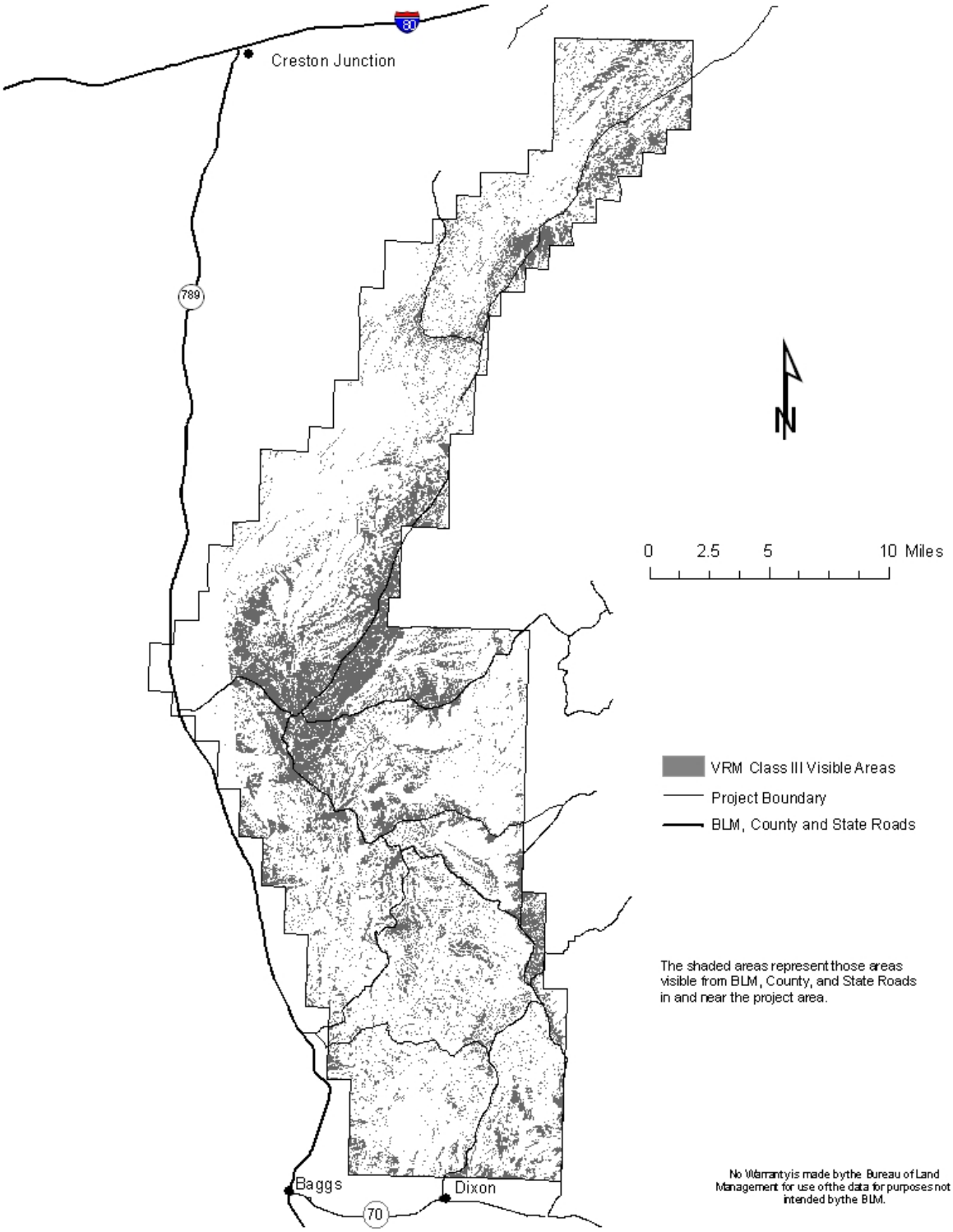
Facilities and roads constructed and visible in VRM Class III under Alternative C are expected to not quite dominate the landscape by becoming the primary focus of and holding viewers' attention as seen from the state, county or BLM roads, and would thus be rated as having a moderate level of impact. With an anticipated reduction in short-term surface disturbance of 68 percent, as compared to the Proposed Action, Alternative C is expected to remain within VRM Class III Management Objectives, and impacts are not expected to be significant.

4.10.3.4 Alternative D

Impacts to visual resources under Alternative D would be similar to the impacts described in the analysis of impacts under the Proposed Action (section 4.10.3.1 above). The acreage of the project area that would be disturbed under Alternative D would be less than the acreage anticipated under the Proposed Action, although the pace of development analyzed under Alternative D is the same as for the Proposed Action. The analyses of both alternatives assumed that operators' reclamation efforts would be successful.

In conclusion, the visual contrast introduced into the ARPA by Alternative D would be high. This level of contrast exceeds the maximum allowable in VRM Class III (96 percent of the ARPA) and is allowable in VRM Class IV (only 4 percent of the ARPA). Therefore, based on the criteria presented in table 4-8, the impact of Alternative D as a whole to visual resources of the ARPA would be significant. Impacts to visual resources from Alternative D would be long term, beginning during development and lasting beyond the life of the project. In addition, Alternative D would potentially leave weak residual impacts on the landscape even after final reclamation at the end of the life of the project because of the time it takes for reclaimed areas to return to pre-disturbance vegetative conditions and because some improved roads would likely be left in place.

Map M-42. Areas Visible from Main Roads in VRM Class III with Slopes <5%.



4.10.4 Summary of Impacts

Predicted change to the characteristic landscape for each action alternative is expected to be equal to or greater than the level acceptable under VRM Class III management objectives. The visual quality of the project area would be affected until successful final reclamation and repopulation of mature native shrub communities. The project area would potentially retain numerous improved project roads, which would create lasting linear features that detract from the existing character of the area.

4.10.5 Additional Monitoring and Mitigation Measures

No additional mitigation measures are necessary under the no action alternative.

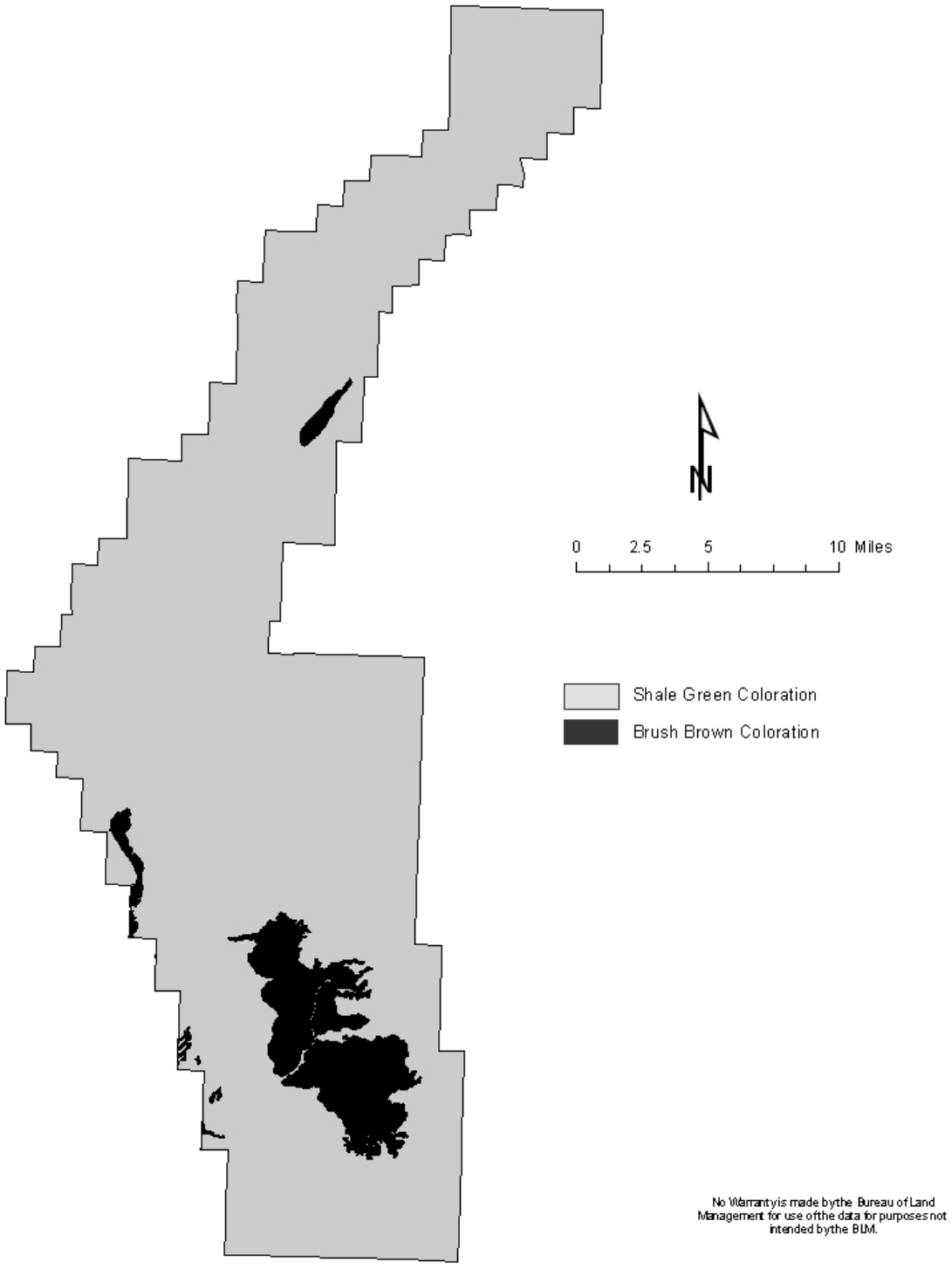
BMPs are warranted in an attempt to keep impacts within the level allowable on VRM Class III lands. In addition, they may reduce conflict in the long run between continued expansion of mineral development and the interests of other users of the ARPA. Shale green facility coloration would blend satisfactorily with the environment in most well locations (approximately 93 percent of the ARPA or 92 percent of the federal surface within the ARPA) as seen above. Areas that would instead require a brown coloration (approximately 7 percent of the ARPA or 8 percent of the federal surface within the ARPA) to blend with brown shrubbery and grasses are shown on map M-43).

Figure 4-4. Proper Coloration for Visual Resource Management Mitigation.

VRM Class III comprises 94 percent of the federal surface in the project area. The operator-committed mitigation measures would not be sufficient to prevent any of the action alternatives from exceeding VRM Class III management objectives. Even BMPs would not be sufficient to keep development within VRM Class III management objectives, as prescribed in figures 4-5 and 4-6.

Alternative C is anticipated to have the maximum visual impact allowable under VRM Class III management objectives, assuming BMPs and additional protections afforded other programs prevent the project from dominating the viewshed. Thus Alternative C would have a moderate visual impact.

Map M-43. Project Area Facility Coloration.



The need for more effective mitigation on all wells is an emerging issue in the GDRA. Although visual sensitivity is not the highest priority for some residents and visitors, a heightened awareness of scenic values and of the existing scenic quality is occurring for some residents and visitors as increasing numbers of sightseers and persons seeking various types of recreational opportunities pass through GDRA lands, including the ARPA.

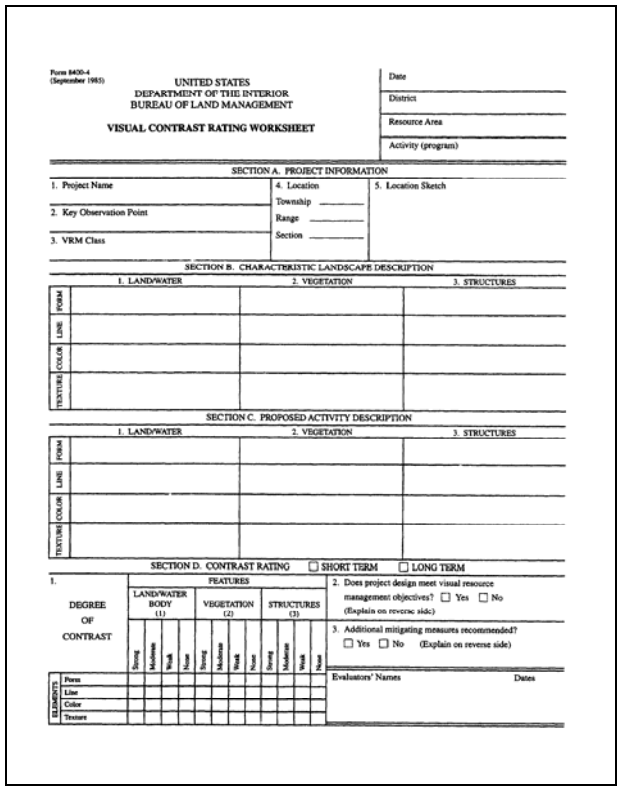
Figure 4-5. Excerpt from Land Use Planning Handbook.

The Land Use Planning Handbook H-1601-1 (03/11/05) provides the following guidance:

I. Visual Resources

Implementation Decisions. Manage resource uses and management activities consistent with the VRM objectives established in the land use plan. Design all BLM resource uses, management activities, and other implementation decisions to meet VRM objectives established in the land use plan. Utilize visual resource management techniques and best management practices to mitigate the potential for short- and long-term impacts. Contrast ratings are required for all major projects proposed on public lands that fall within VRM Class I, II, and III areas which have high sensitivity levels (see Handbook H-8341-1 for contrast rating procedures).

Figure 4-6. The Visual Contrast Rating Worksheet, Form 8400–4, for the Project would be filled out after an alternative is selected.



Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date
District
Resource Area
Activity (program)

SECTION A. PROJECT INFORMATION

1. Project Name
2. Key Observation Point
3. VRM Class
4. Location
Township
Range
Section
5. Location Sketch

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM			
LINE			
COLOR			
TEXTURE			

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM			
LINE			
COLOR			
TEXTURE			

SECTION D. CONTRAST RATING ☐ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

	FEATURES											
	LAND/WATER BODY (1)				VEGETATION (2)				STRUCTURES (3)			
	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None	Strong	Moderate	Weak	None
REMARKS: Form												
Line												
Color												
Texture												

2. Does project design meet visual resource management objectives? ☐ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended? ☐ Yes ☐ No (Explain on reverse side)

Evaluators' Names Dates

4.11 Cultural Resources

4.11.1 Introduction

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) as amended, Governing Regulations, and 36 CFR 800. Laws and regulations concerning cultural resources stipulate that the federal government take into consideration the effects of an action on significant cultural resources. This requires that cultural resources within the proposed area of potential effect must be identified and evaluated. A determination of effect is made and measures are then formulated to mitigate or minimize any effects to those historic properties included in, or eligible for, the NRHP.

The ARPA database contains at least 423 cultural resource sites, as summarized in section 3.11. Site types include prehistoric camps including burial, habitation, ceramic/pottery, stone circles, rock shelters, petroglyphs, ground stone/milling activities, and quarries. The prehistoric lithic debris sites include debris scatters/procurements, ceramics, ground stone/milling activities, and quarries.

Historic sites include: trails, stage stations, inscriptions, cairns, debris/trash, ranches, irrigation ditches, ranching/herding/corrals, and a post office. Historic trails include: the Overland Trail, the Cherokee Trail, and the Rawlins to Baggs Road. The Washakie Station (listed on the NRHP) and the Sulphur Springs Stage Station were stops along the Overland Trail. The Sulphur Springs Station was also utilized by the Rawlins to Baggs Road. Other Stage Stations documented in the ARPA associated with the Rawlins to Baggs Road include Muddy Bridge Station and Willow Station. The JO Ranch is a prominent eligible property within the project area.

Prehistoric/historic sites are characterized as prehistoric camp/historic debris scatters or lithic scatters/historic debris scatters. Of the 423 sites recorded in the EIS analysis area to date, 32 percent are recommended eligible (n=135) for nomination to the NRHP, 34 percent are recommended not eligible (n=145), and 34 percent remain unevaluated (n=143). Before 2003, approximately 20 percent of the area had been inventoried at a Class III level and site density is projected to be 0.008 sites per acre. Certain topographic settings have greater archaeological sensitivity including eolian deposits (sand shadows and sand sheets) and, to a limited degree, colluvial deposits along lower slopes of ridges. Sensitive areas include drainages, such as Muddy Creek, Cherokee Creek, Wild Cow Creek, Sixteen Mile Draw, Cottonwood Creek, and Deep Creek along with their tributaries. The numerous springs in the area would likely be associated with cultural resources.

The BLM has designated a quarter-mile buffer surrounding the contributing segments of the historic trails and associated sites as highly sensitive and would result in the exclusion of disturbance of approximately a maximum of 20,583 acres in order to protect the physical remains. The number of acres excluded from development would possibly be less as contributing segments of the Cherokee Trail are determined upon final acceptance of the inventory. For management purposes, the BLM has established a two-mile analysis area around the trails for consideration of the elements of setting as defined as those elements of integrity of location, feeling, and association that contribute to the eligibility of the trails or associated sites. While two miles is the standard distance for consideration of setting, it does not preclude the consideration of a larger area, depending on the circumstances.

4.11.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and State (WSLUC 1979) land use plans prescribe the following management objectives associated with cultural resources:

- To protect and preserve representative samples of the full array of cultural resources for the benefit of scientific and socio-cultural use by present and future generations;
- To ensure that cultural resources are given full consideration in all land-use planning and management decisions;
- To manage cultural resources so that scientific and socio-cultural values are not diminished, but rather are maintained and enhanced; and
- To ensure that the BLM's undertakings avoid inadvertent damage to cultural resources both federal and nonfederal.

Impacts are considered significant if management actions result in effects to properties listed or determined eligible for listing on the NRHP or considered important to Native American groups as measured by:

1. Destruction or alteration of all or part of a property;
2. Isolation of a cultural resource from, or alteration of, its surrounding environment;
3. Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting; and
4. Neglect and subsequent deterioration.

Significance, under NEPA, is detailed in 40 CFR 1508.27 and is distinct from archeological significance. Cultural resource significance is measured by four categories defined by the Code of Federal Regulations (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:
>
> A. Are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. Are associated with the lives of persons significant in our past; or
>
> C. Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D. Have yielded, or may be likely to yield information important in prehistory or history. (36 CFR 60.4)"

For cultural sites, both prehistoric and historic, significance is primarily judged either by the site's ability or potential to yield information important in prehistory or history (criterion D) or the site's association with events that have made a significant contribution to the broad patterns of our history (criterion A). Each site's importance, however, is determined individually, so the existence of sites eligible under criteria B or C must not be discounted.

The BLM meets its responsibilities under Section 106 of the NHPA through the implementation of a national Programmatic Agreement among the BLM, the Advisory Council on Historic Preservation (ACHP), the National Conference of State Historic Preservation Officers, and a state protocol with the Wyoming State Historic Preservation Office (SHPO) rather than by following the procedure set forth in the ACHP's regulations (36 CFR Part 800).

The preferred strategy of cultural resource management is avoidance of affect to those elements that contribute to the eligibility of a historic property. If this strategy cannot be implemented, mitigation of effects by project redesign, data recovery, project cancellation, or numerous other mitigation options should be implemented.

4.11.3 Direct and Indirect Impacts

4.11.3.1 Proposed Action

At the Proposed Action's rate of disturbance, if the density of site types is predicted at 0.008 sites per acre, it is estimated 126 sites could be disturbed. Of those, 32 to 40 percent could be eligible for the NRHP. These calculations assume that the area-wide site density is equal across the ARPA and that the 20 percent area inventoried is a valid sample.

Direct impacts would primarily take the form of alteration or disturbance of previously unidentified sites. Physical disturbance of eligible sites could result from any disturbance activity. Indirect impacts could result from associated erosion resulting from the changes in surface hydrology. In turn, the loss of integrity of surface cultural material or the exposure and degradation of subsurface material and their contexts could be expected. Indirect impacts also would result from the removal of vegetation, which would serve to destabilize the soils and in turn cause additional erosion of site areas. In addition, as access to previously-isolated areas becomes more abundant, the frequency of human intrusion and the possibility of looting also increase.

Where the setting of the trails and associated sites contributes to NRHP eligibility, actions resulting in the introduction of visual elements that diminish the integrity of the property's significant historic features would be a factor.

4.11.3.2 Alternative A (No Action)

Under the no action alternative, the Proposed Action would not be implemented and additional drilling would be allowed on federal lands; however, individual APDs would be approved on a case-by-case basis. No additional impacts to cultural resources could be expected beyond those analyzed in the previous environmental assessments for the Atlantic Rim pods.

4.11.3.3 Alternative C

In general, constraints under Alternative C would focus on surface disturbance limitations: limited operating periods, modification of drilling and construction practices, and in some cases

no surface occupancy/disturbance. Under this alternative, sensitive cultural resource areas would be eliminated from development or be subject to extensive mitigation measures. Direct impacts of sites not visible during inventory (discovery situations) would be the same as with the Proposed Action. A by-product might be the reduction of indirect effects resulting from unauthorized collection of cultural material due to lower access into the area.

4.11.3.4 Alternative D

Direct and some indirect impacts to cultural resources could be expected to occur at a lower rate and intensity than the Proposed Action due to the reduced disturbance goal of 20 percent. Impacts to historic setting would be lessened in direct correlation to the success of vegetation reclamation/restoration.

4.11.4 Impacts Summary

Gauging the effect of any impact depends on the level of information available for that particular property provided by inventory or testing data. If cultural resources on or eligible to the National Register are to be adversely impacted by the proposed undertaking, the applicant, in consultation with the surface managing agency and the SHPO and with input from other interested parties per 36 CFR Part 800.6 and the Statewide Protocol Section VII, shall develop a mitigation plan designed to eliminate the adverse effects. Construction would not proceed until the terms of the mitigation plan are satisfied. Impacts to historic properties from projects occurring in the absence of a federal undertaking (federal authorization) would be beyond federal control.

4.11.5 Additional Mitigation Measures

The additional mitigation measures apply to all alternatives because the primary focus of effects to cultural resources is based on location and secondly the extent of the surface disturbance. None of the alternatives propose significant development modifications; therefore, impacts to cultural resources would be similar under all the alternatives.

Additional mitigation measures may include, but are not limited to, the following measures listed below. These measures will be incorporated into an agreement or agreements established under the Wyoming state cultural resources protocol. BLM will seek to establish a programmatic agreement between the BLM, SHPO, project proponents and interested parties that will address site-specific impacts and mitigation measures for all sites where setting contributes to NRHP eligibility.

Common to All Alternatives:

Mitigation of Direct Impacts:

- Construct smaller well pads,
- Construct narrower roads,
- Construct multiple well locations per pad to decrease the total acres of disturbance,
- Brush hog ROWs,

- Allow no surface disturbance within a quarter mile of contributing segments of historic trails or trail-associated sites, and

- Limit trail crossings to existing disturbance corridors or non-contributing segments, unless otherwise determined by BLM in consultation with SHPO.

Mitigation of Impacts to Setting Where Contributory to Eligibility:

- Begin reclamation at the time most optimal to regenerate the native species,

- Replace native shrubs to decrease visibility,

- Construct roads in minimally visible areas,

- Relocate project or hide disturbance, and

- Use matting on ROWs during construction to minimize surface disturbance and visibility.

4.12 Socioeconomics

4.12.1 Introduction

Implementation of any of the action alternatives or the no action alternative would result in both positive and adverse socioeconomic effects. Positive effects of the action alternatives would include increases in economic activity; income; employment; and local, state, and federal government tax and royalty revenues. Adverse effects of the action alternatives would include disruptions in activities and lifestyles of those who own private land or use public land within the ARPA, including ranchers, grazing operators, hunters, and other recreation visitors. These disruptions could result in effects on the grazing and recreation sectors of the Carbon County economy. Implementation of the no action alternative would avoid the disruption of activities and lifestyles associated with the action alternatives, but would also forego the employment and fiscal benefits associated with these alternatives.

4.12.2 Impact Significance Criteria

The following criteria were used to determine whether socioeconomic impacts of the Proposed Action and alternatives would be significant:

1. An increase in county or community population that would strain the ability of affected communities to provide housing and services or otherwise adapt to growth-related social and economic changes;

2. An aggregate change in revenue and expenditure flows likely to result in an inability on the part of affected units of government to maintain public services and facilities at established service levels;

3. Permanent displacement of residents or users of affected areas that would result from project-induced changes in or conflicts with existing uses or ways of life; or

4. Disproportionately high and adverse environmental or human health impacts to an identified minority or low-income population, which appreciably exceed those to the general population around the project area.

4.12.3 Direct and Indirect Impacts

Socioeconomic effects can cover many topics. In this section, the following impacts are analyzed under each alternative:

- Economic effects;
- Alternatives-related effects on other economic activities within the ARPA;
- Employment and population effects;
- Housing effects;
- Effects on community services;
- Fiscal effects;
- Local attitudes, opinions, and lifestyles; and
- Environmental justice.

4.12.3.1 Proposed Action

Economic Effects

The Proposed Action, as described in chapter 2 of this assessment, would involve an estimated $2.1 billion capital investment for drilling, completion, gathering systems, and field infrastructure, excluding the investment for the interim drilling period. This investment would occur over 20 years.

Development and operation of the Proposed Action would require goods and services from a variety of local, regional, and out-of-state contractors and vendors in the oil and gas service industry and other economic sectors. Expenditures by the operators for these goods and services, coupled with subsequent employee and contractor spending of earnings and profits, would generate the economic effect of increased income in southwestern Wyoming, the State of Wyoming, and the nation as a whole. These effects could be reduced in magnitude by Proposed-Action-related reductions in other economic sectors, primarily those that include grazing and outdoor recreation (primarily hunting), as discussed in the next subsection.

For this assessment, infrastructure and production estimates provided by the operators were used as inputs for a regional economic modeling process using the IMPLAN economic modeling software. IMPLAN is an input-output-based model originally developed to assist the USDA-FS in land resource management planning. Subsequently, the model and related software were transferred into the private sector, where it is the subject of ongoing refinement and enhancements to provide the analytical capacity to address a broader range of economic and impact planning issues. IMPLAN is widely recognized and accepted in regional economic and economic impact assessment circles. The model maps the flow of dollars through the region's economy and provides information about the interaction of individual sectors within the regional economy. The model considers both the direct effects on the producing sector(s) of a change in economic activity and the secondary effects on other local sectors due to the linkages within the region's economy. The model was used for the socioeconomic portion of the BLM's Southwest Wyoming Resource Evaluation (UW 1997) and for a variety of other NEPA assessments and BLM planning initiatives including the current revisions to the Rawlins RMP.

IMPLAN is a static model that assumes that current relationships between sectors will remain similar in the future. The model does not consider changes in other sectors of the economy unless they are also specified as inputs. For this assessment, only the economic activity associated with the Proposed Action was considered in the IMPLAN modeling process. As noted, the activities associated with the Proposed Action have the potential to affect other economic activities, such as reduced grazing and outdoor recreation within the ARPA. These potential effects are not addressed within the IMPLAN modeling process but are discussed below in the following subsection.

The model calibration and other elements of this assessment are based on the following assumptions:

- Drilling and field development in the ARPA would occur over 20 years (figure 2-1), during which a total of 1,800 CBNG wells would be drilled, in addition to the 116 wells drilled during the interim drilling period (The model assumes a success rate of 100 percent). For the purposes of this assessment, it is assumed that 200 conventional wells would also be drilled, also with a success rate of 100 percent.

- The operators estimate that each CBNG well would produce about 750,000 thousand cubic feet (MCF) of natural gas over 13 years (figure 4-7). Under the Proposed Action, some wells would be drilled late in the 20-year assessment period; therefore, production could continue for 13 years after the 20-year drilling and field-development period ends.

- Although there are existing conventional gas wells within the ARPA, the operators have not estimated production associated with the conventional wells included in this assessment. Omitting production estimates for conventional wells may understate long-term economic, employment, and fiscal benefits of production if drilling efforts in conventional formations meet with substantial success. However, because the employment and population effects of production would be substantially lower than employment and population effects of drilling and field development, which are included, the assessment would not understate socioeconomic effects.

- Each CBNG well would require an average of $633,000 to drill and complete; an additional per well average of $379,000 would be spent on gathering and electrical systems, gas line laterals, compressor stations, and injection facilities. Wells drilled to deeper conventional targets would be drilled with essentially the same equipment although completion and production techniques would differ. Consequently, conventional well costs are assumed to be approximately 50 percent higher than CBNG well costs.

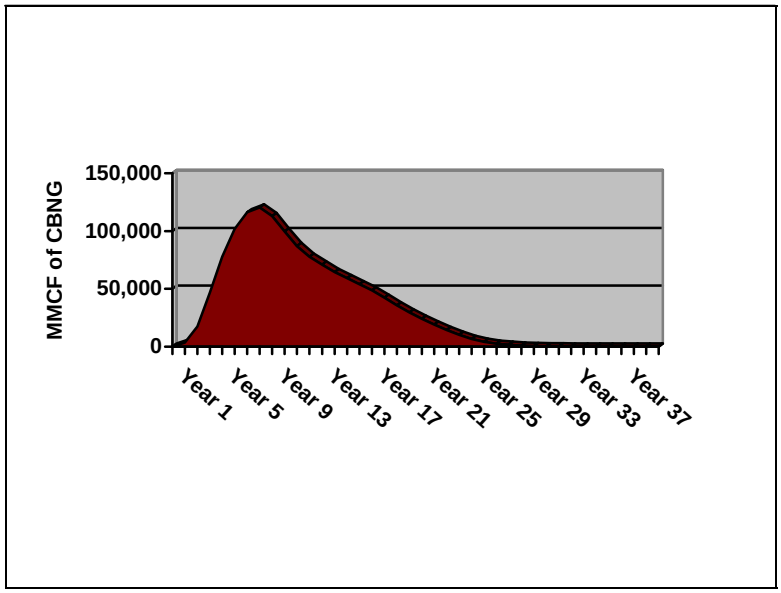
- For the purpose of the assessment, wells would be drilled according to the schedule presented in figure 2-1.

- Only a portion of the expenditures in each category would occur within southwest Wyoming; other materials and labor purchases would occur elsewhere in Wyoming or out of state. Estimates of local and non-local expenditures have been developed for each drilling and field development category (e.g., rig costs, labor costs, fuel costs, and pipe costs) based on actual AEPC expenditures during the interim drilling period.

- Revenues, expenditures, and economic effects are expressed in terms of constant 2004 dollars.

- Annual average wellhead gas prices are based on the $4.25 per MCF estimate for gas prices beyond 2005 contained in the October 2004 Wyoming Consensus Revenue Estimating Group Wyoming State Government Revenue Forecast (CREG 2004). These are likely conservative estimates. Note that CREG increased wellhead price estimates for natural gas to $6 per MCF for 2006 and beyond in October 2005. Spot prices at Wyoming hubs were over $10 per MCF during the fall of 2005 as a result of hurricanes Katrina and Rita.

Figure 4-7. Estimated Project–Related Coal Bed Natural Gas Production.



Note:
Excludes production from the Interim Drilling Program.
Source: AEPC 2004.

Use of the foregoing assumptions and the IMPLAN model allow a reasonable but conservative assessment of the economic impacts of the Proposed Action; however, economic effects of all action alternatives would be different than those forecast by the model if actual conditions vary substantially from these assumptions.

Estimated economic effects of Proposed Action drilling and field development are displayed in table 4-10. Based on the foregoing inputs and assumptions, an estimated annual average direct regional expenditure of about $49 million would result in an annual economic impact of about $62 million in southwest Wyoming, or a total economic impact of almost $1.2 billion over the 20-year drilling cycle.

Estimated annual drilling and field development employee earnings in southwest Wyoming would average almost $22 million or about $434 million total over 20 years. These earnings would support an average of 578 annual job equivalents (AJEs). AJEs reflect an aggregation of all employees (existing and new) whose employment would be supported in whole or in part by Atlantic Rim project spending. The term AJE is used to emphasize that these are not all

discrete or separate new jobs created by the Proposed Action, rather they represent both new and existing jobs and portions of jobs that are wholly or partially supported by the incremental economic activity associated with the Proposed Action.

Table 4-10. Estimated Economic Effects of Drilling and Field Development: Proposed Action.

	Direct Regional Expenditures[1]	Total Economic Impact[2]	Total Earnings[3]	Employment (AJE) Direct, Indirect & Induced)[4]
Annual Average	$49 million	$62 million	$21.7 million	578
Total	$981 million	$1.2 billion	$434 million	n/a

Notes:
[1]Direct regional expenditures are purchases from vendors located in Carbon and Sweetwater counties by the operators and their contractors for labor, goods, and services.
[2]Total economic impact reflects project-related direct expenditures and subsequent rounds of spending by vendors and employees in Carbon and Sweetwater counties.
[3]Total earnings reflect wages and salaries paid to direct, indirect, and induced employees associated with Proposed-Action-related drilling and field development.
[4]Direct, indirect, and induced employment is defined under Employment and Population Effects below.
Source: IMPLAN Model results based on information provided by AEPC.

Estimated economic effects associated with production (not including production associated with the interim drilling period) are presented in table 4-11. Based on the assumptions outlined in the earlier part of this assessment, natural gas production would result in $6.4 billion in total economic impact over the 32-year production cycle (production impact estimates include impacts outside southwest Wyoming), and average annual earnings of $6.6 million supporting 161 average AJEs. Production-related employment (direct, indirect and induced, as defined in the subsections below) would begin at an estimated 14 AJE in Year 2, increase to 461 in Year 8, and then steadily decrease. Production-related earnings and employment effects would occur in Carbon and Sweetwater counties.

Table 4-11. Estimated Economic Effects Associated with Proposed Action-Related Production.

	Total Economic Impact[1]	Total Earnings[2]	Employment (AJE) Direct, Indirect & Induced[3]
Annual Average	$200 million	$6.6 million	161
Total	$6.4 billion	$210 million	n/a

Notes:
[1] Total economic impact is the total economic activity that occurs in the region as a result of production including the direct effect, which represents the dollar value of the industry's production plus the secondary effects of increased business activity for industries that support the industry where the production occurs.
[2] Total earnings reflect wages and salaries paid to direct, indirect, and induced employees associated with Proposed-Action-related drilling and field development.
[3] Direct, indirect, and induced employment is defined under Employment and Population Effects below.
Source: IMPLAN model results based on information provided by AEPC.

As shown in table 4-12, the combined drilling, field development, and production phases of the project would generate an estimated $7.6 billion in total economic impact, including $644 million in total earnings in southwest Wyoming over the 40-year life of project used for this assessment.

Table 4-12. Combined Proposed Action-Related Drilling and Production Economic Effects.

	Direct Expenditures[1]	Total Economic Impact[1]	Total Earnings	Average Annual Employment (AJE) Direct and Indirect)
Total	$ 6.7 billion	$7.6 billion	$644 million	578 drilling /161 production

Note:
[1] Includes impacts outside southwest Wyoming.
Source: IMPLAN model results based on information provided by AEPC.

Proposed-Action-Related Effects on Other Economic Activities within the ARPA

As outlined in section 3.11, existing land uses within the ARPA include wildlife habitat; grazing; hunting and other dispersed recreation; and oil and gas exploration, production, and transmission.

Grazing. The economic assumptions for grazing contained in appendix 35 of the Draft Rawlins RMP estimate that cattle grazing generates $64.36 per AUM in total economic impact in the region, and results in $18.77 in earnings/AUM and .000709 jobs/AUM. Each AUM of sheep grazing results in $42.36 in regional economic impact, $5.83 in earnings, and generates .0009513 jobs.

Potential impacts to grazing activities and range resources were discussed in section 4.6. In that assessment, it is estimated that grazing use of the allotments in the ARPA is 91 percent cattle and 9 percent sheep. One potential economic effect of the Proposed Action on grazing activities would be reductions in AUMs associated with losses of forage due to temporary and long-term disturbance. The total economic impact of reductions in AUMs associated with initial disturbance (2,026 AUMs) would be $126,382, assuming that the loss of forage associated with disturbance resulted in actual reductions in AUMs. Because the initial disturbance would be over the 20-year drilling and field development phase of the project, the economic impact would similarly be spread over the life of the project. It routinely takes more then one season for reclaimed areas to become established. Consequently, economic impact associated with initial disturbance would be multiplied for each year required to re-establish forage, again assuming that disturbance resulted in actual reductions in AUMs.

However, the grazing assessment in section 4.6 concludes that the amount of forage lost as a result of Proposed-Action-related disturbance would be less than the normal variations in forage availability from year to year. Therefore, disturbance would be minimal in the short term and may actually increase available forage in the long term because reclaimed vegetation would consist of herbaceous species, which cattle prefer. Consequently, short- or long-term disturbance-related reductions in AUMs for grazing allotments within the ARPA resulting from implementation of the Proposed Action cannot be predicted with certainty.

Some aspects of natural gas development may be useful for grazing operators; for example, improved road access to grazing areas could facilitate livestock management for some operators, reducing costs. Other aspects of development could generate reduced economic impacts to ranchers and grazing operators. Dust could reduce the palatability of forage near disturbed areas, requiring more intensive livestock management practices to ensure adequate forage. Incursion of noxious and invasive species could reduce available forage and require more intensive management practices. Operators may also have to manage livestock more

intensively to avoid drilling and field development activity or to retrieve livestock scattered because of unrepaired damage to fences or cattle guards. More intensive livestock management practices would result in increased costs to operators. Unreported vehicle livestock collisions could also result in economic losses for ranchers and grazing operators.

The collective effects of the above impacts could induce some grazing operators to forgo use of their allotments for one or more seasons during periods of intensive development. If withdrawal of cattle were to occur, if these grazing operators could not find comparable grazing lands within the county at comparable costs, or if they chose to forgo grazing entirely for one or more seasons, the economic impact associated with that operator's AUMs would also be forgone. In this case, according to the range assessment in section 4.6, losses associated with BLM allotments could range from 6,000 AUMs, which would generate a loss of $374,280 in total economic impact, to 12,000 AUMs, a loss of $748,560. Including both BLM and private lands, reductions in AUMs could range as high as 20,000 AUMs, which would result in a total economic impact of $1,247,600. The economic impact of reductions in AUMs associated with grazing operators opting to forego use of their allotments would occur each year that cattle are withdrawn from the allotment, assuming that other grazing lands were not available.

If grazing operators were to forgo use of allotments, areas that were reclaimed would have more time to become established, reducing the potential for the spread of weeds. This could provide some economic benefit to grazing operators when they resumed use of the allotment.

Recreation. According to the recreation assessment contained in section 4.9, some hunters and other recreation visitors to the ARPA may be temporarily displaced from the area by drilling, field development activity, land disturbance, and reductions in game. A lesser number of hunters and recreation visitors may be displaced in the long term because of the loss of undisturbed landscapes and solitude. The above-referenced University of Wyoming report provided estimates of per-day total regional economic impact that range from $156 per day for non-resident hunting, $159 for non-resident OHV use, and $51 per day for non-resident general recreation (UW 1997). Estimates of regional jobs associated with these recreation activities range from 0.005/visitor day for non-resident hunting, 0.003 for non-resident OHV use to 0.001 per day for general non-resident recreation.

Estimates of the number of recreation visitors to the ARPA are not available. Estimates of the number of hunters and other recreation visitors who would be displaced temporarily or in the long term by the Proposed Action are similarly not available. Estimates of use of the hunt areas that include the ARPA are presented in section 3.9. Based on these estimates and the total economic impact estimates of non-resident mule deer, elk, and antelope hunting contained in the draft Rawlins RMP, total economic impact of non-resident big game hunting in the hunt areas that contain the ARPA is about $1.5 million annually. Because the hunt areas are substantially larger than the ARPA, the portion of total economic impact attributable to non-resident hunting within the ARPA is smaller than the above estimate and reductions in hunting would likewise result in economic impacts smaller than the above estimate.

Big game hunting is economically important to communities near the ARPA. A number of landowners within the ARPA provide outfitting services to non-resident hunters and some lease their land to outfitters or allow hunting for a fee. These activities provide additional income for landowners; in years when cattle or sheep prices are low, they provide a substantial portion of total income (Caricco 2005, Hicks 2004, Hansen 2004, and O'Toole 2004). Also motels, RV parks, cafes, convenience stores, and gas stations in the Little Snake River Valley derive a

portion of their business from big game hunters (Hicks 2004). Consequently, substantial reductions in big game hunting within the ARPA would result in reduced incomes and have economic effects on landowners, outfitters, and businesses in the Little Snake River Valley. For individual landowners and outfitters, these losses could range from minimal to substantial depending on the location of natural gas development in relation to a specific property, the timing of development, actual effects on big game and big game habitat, climatic conditions, the duration of effects, and the success of mitigation measures. Economic effects to businesses in the Little Snake River Valley could be offset by the economic activity associated with the Proposed Action.

Employment and Population Effects

Employment. Population effects of the Proposed Action would be associated with direct, indirect, and induced employment. Direct employment would include workers in oil and gas service occupations, construction, or other sectors involved in some aspect of Proposed-Action-related drilling, field development, or production. Indirect employment would include jobs and portions of jobs created by industries purchasing from other industries in response to local spending associated with the Proposed Action. Induced employment would be created by employees spending income earned from the Proposed Action, whether from direct, indirect, or induced employment; induced employment would occur across most economic sectors.

As a result of the Proposed Action, direct, indirect, and induced jobs would be created in Carbon and Sweetwater counties, and would include:

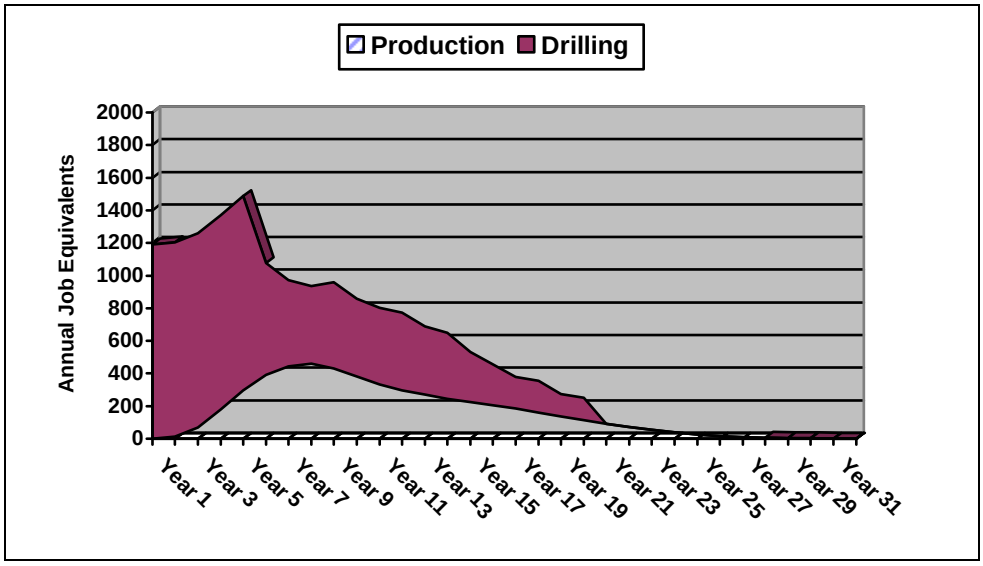
- Temporary jobs, primarily in drilling, natural gas service, and related construction industries. These temporary jobs would be primarily filled by non-local workers who would relocate to the area for the duration of the particular work assignment. To a lesser extent, it would also apply to existing southwestern Wyoming residents. Work assignments can range in length from 6 months to a matter of hours at any one location.

- Existing direct, indirect, and induced jobs, as well as portions of existing jobs that have been supported by natural gas drilling, field development, or production activities in the past and would continue to be supported by these activities under the Proposed Action.

- New jobs and portions of new jobs filled by existing southwestern Wyoming residents or by in-migrant workers who relocate to southwest Wyoming for employment. In-migrant workers are defined as workers who move into the area for project-related employment purposes.

Figure 4-8 displays estimated total employment associated with the drilling/field development and production phases of the Proposed Action.

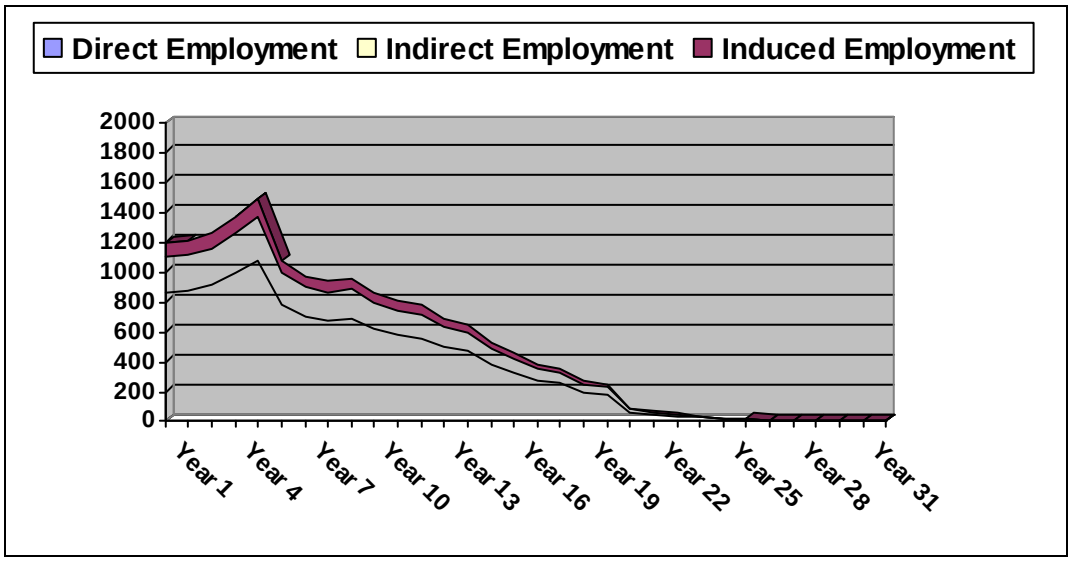
Figure 4-8. Estimated Proposed Action Total Drilling and Production Employment: Direct, Indirect, and Induced.



Source: IMPLAN model results based on information provided by AEPC.

Figure 4-9 displays the direct, indirect, and induced components of Proposed-Action-related employment.

Figure 4-9. Components of Total Proposed Action-Related Employment: Direct, Indirect, and Induced.



Source: IMPLAN model results based on information provided by AEPC, 2004.

Population. Although the employment and income effects of the Proposed Action would be substantial and sustained at a high level of activity for 8 to 10 years, the Proposed Action is likely to result in moderate long-term population growth. A number of factors in the natural gas

industry and the local economy would likely intervene to reduce the population effects of the economic stimulus.

Chief among these is the existence of a mature oil and gas service industry infrastructure in southwestern Wyoming. Drilling and field development activities in the ARPA would be performed by a combination of local contractors and regional and national oil and gas service firms, many with local presences in these same communities. Local contractors are primarily located in Rawlins and Rock Springs, and to a lesser extent, the Little Snake River Valley and Wamsutter. Between 1995 and 2004, APDs in Carbon and Sweetwater counties increased over 300 percent. In response to this activity, oil and gas service firms have expanded, particularly in Rock Springs, which is the major oil and gas service center for southwestern Wyoming.

During the 9-year period that drilling activity increased dramatically in the two counties, Carbon County resident population decreased by 5 percent and Sweetwater County resident population decreased by 7 percent. There are several apparent reasons for this phenomenon.

- Many oil and gas drilling and service companies are staffed by employees with primary residences in other parts of the country. These employees relocate to Carbon and Sweetwater counties in single status (i.e., without family members) on a temporary basis. They return to their homes when they are off shift or at the end of their work assignment (Blodgett 2004, Kilgore 2004, and Kot 2004). In some cases, these employees are considered double transients who temporarily relocate to a service company's office in Rock Springs, travel to other communities, stay in motels or RV parks for a matter of days, and return to Rock Springs for another assignment (Blevins 2004). Because of their temporary nature, these employees are often not counted in population estimates even though they generate demand for temporary housing and for some local government services.

- Coal mining, trona mining/soda ash manufacturing, and logging and lumber manufacturing employment decreased in both counties during the period. Some mine and timber industry employees may have obtained work in the oil and gas service industry and some indirect and induced employees may have retained jobs they otherwise would have lost because of economic activity in the oil and gas sector. As a result, increasing oil and gas industry activity may have slowed population decline in the two-county area.

- At the beginning of the accelerated drilling cycle, oil and gas service firms may have had some underutilized capacity and the local labor pool may have supplied a portion of the increased labor demand.

- During the mid-1990s, several major construction projects helped maintain population in Sweetwater County. As these projects were completed, workers left, which contributed to population decline.

Given that the allowable drilling period on public surface in the ARPA is limited in many areas and generally falls within June through October only, it is likely that many drilling and gas field service workers would continue to relocate to Carbon and Sweetwater counties on a temporary, single status basis. This assumption is supported by the fact that school enrollment in Carbon and Sweetwater counties declined by 26 and 29 percent, respectively, during the 9-year period when drilling increased by over 400 percent, indicating that gas service industry workers have

not relocated with families. Declines in school enrollment are also a result of declines in other employment and of aging populations in the two-county area. Indications are that school enrollment is beginning to increase in Rawlins and the Little Snake River Valley (Herold 2005, Kilgore 2005).

As noted above, the natural gas service industry in Carbon and Sweetwater counties has expanded considerably over the last several years in response to the increased drilling and field development activity in southwest Wyoming. It would likely be able to accommodate some portion of the activity associated with the Proposed Action with existing infrastructure and labor force. In addition, it is presumed that the local portion of field construction and gas service industry employment was already in place to serve development under the Atlantic Rim pods (about 40 percent of the peak-year of the Proposed Action).

For this assessment, each employment category (direct, indirect, and induced) has been assigned a residency status (non-local temporary, local, and in-migrant) depending on the characteristics of the work, the existing labor pool, and historical labor factors in southwestern Wyoming. The "local" category is further divided into existing employees and the smaller category of new workers. Table 4-13 displays the hiring status factors used for this assessment.

Table 4-13. Hiring Status of Proposed Action-Related Employment.

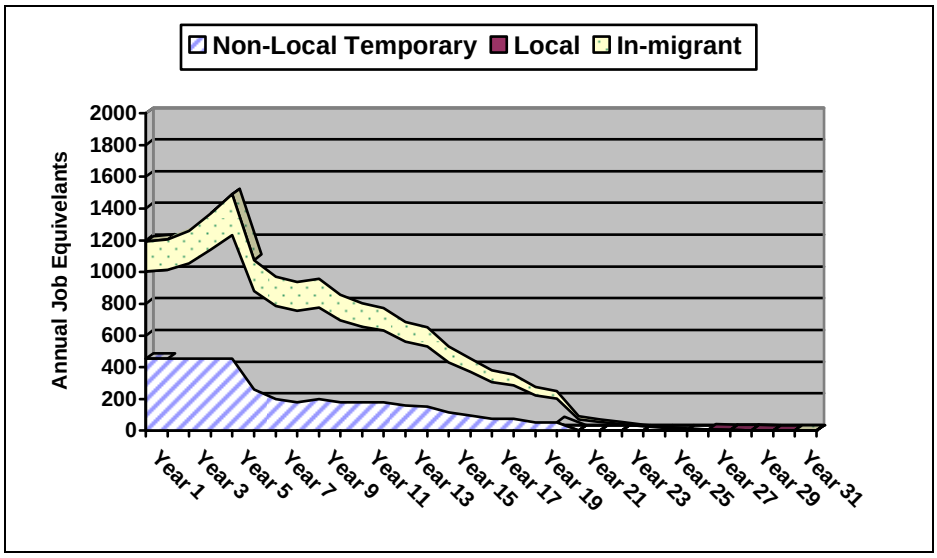
Employment Category	Non-Local Temporary	Local		In-Migrant
		Existing Employees	New Hires	
Drilling/Field Development				
Direct	50%	30%	5%	15%
Indirect	25%	45%	5%	25%
Induced	0%	75%	10%	15%
Operations				
Direct	0%	20%	30%	50%
Indirect	0%	75%	10%	15%
Induced	0%	50%	35%	15%

Prepared by: BCLLC

Figure 4-10 displays the estimated non-local temporary, local, and in-migrant components of Proposed-Action-Related employment. During the fifth year of drilling, when an estimated peak of 1,488 direct, indirect, and induced AJEs would be associated with Proposed-Action-related activities, an estimated 453 (30 percent) would be non-local and temporary, 780 (52 percent) would be local, and 256 (17 percent) would be in-migrants. The percentage of locally hired workers reflects the local portion of the 40 percent of the drilling and field development workforce that has been working on the Atlantic Rim pods.

The distinction between non-local temporary, local, and in-migrant workers is useful because each would have different population implications and different demands for community services.

Figure 4-10. Components of Proposed Action-Related Employment.



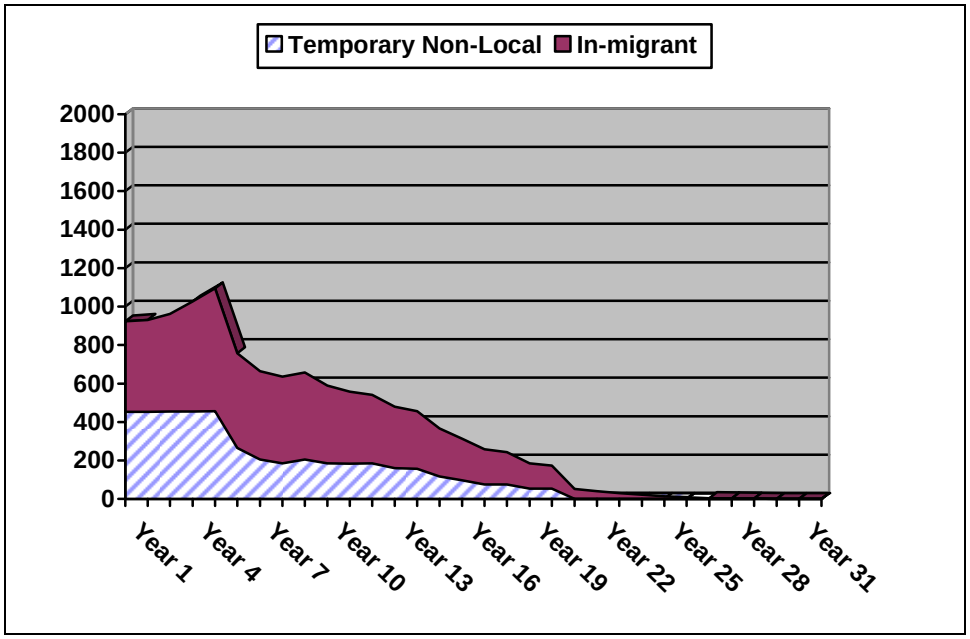
Note:
Local category includes both existing workers and new hires.
Prepared by: BCLLC

For this assessment, temporary non-local workers are assumed to relocate to southwestern Wyoming in single status, during a limited drilling season each year. Local workers are assumed to be currently living and working in southwestern Wyoming. In-migrant workers are assumed to relocate to southwestern Wyoming bringing an average household size of 2.5 persons, the average household size for the State of Wyoming at the time of the 2000 census. Based on these assumptions, the Proposed Action would result in a peak of 456 additional non-local temporary workers during the Year 1 through Year 5 and a peak in-migrant population of 1,096 during Year 5 of the Proposed Action (See figure 4-11).

The Proposed-Action-related population has been distributed to Rawlins (80 percent), Baggs and Dixon in the Little Snake River Valley (just over 10 percent), and Wamsutter (just under 10 percent) based generally on the size of the community, proximity to the ARPA, and available housing. Using these percentages, Rawlins would receive a Proposed-Action-related population increase of 873 persons (362 temporary and 511 longer term) during the peak (Year 5), Baggs and Dixon would receive a total of 113 (49 temporary and 64 longer term), and Wamsutter would receive a total of 109 (45 temporary and 64 longer term) (figure 4-12). It is important to note that these numbers are in addition to the population associated with existing direct, indirect, and induced workers.

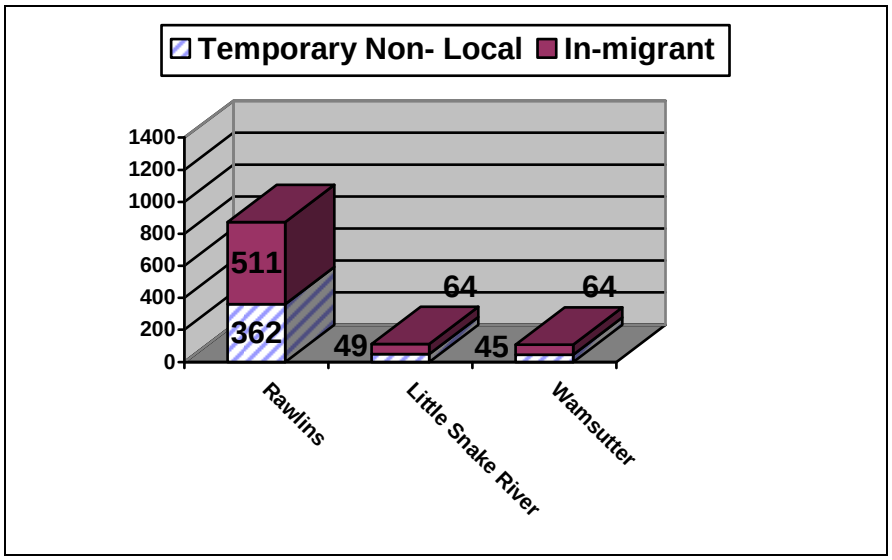
Based on the above population estimates and the percentage of total population enrolled in school during 2000, an estimated 92 school-age children associated with the Proposed Action would be enrolled in schools in Rawlins during the peak year, 11 in the Little Snake River Valley, and 12 in Wamsutter.

Figure 4-11. Proposed Action-Related Peak, Temporary, Single-Status and In-migrant Population.



Prepared by: BCLLC

Figure 4-12. Distribution of Peak Proposed Action-Related Population to Communities.



Prepared by: BCLLC

The Wyoming Division of Economic Analysis projects that Rawlins, Baggs, Dixon, and Wamsutter would have small decreases in population over the next several years (WDAI 2004c). If these projections are correct, the population associated with the Proposed Action may reduce population loss in these communities. However, it is more likely that the anticipated high levels of natural gas development in southwest Wyoming may result in higher total population gain. An increase is particularly likely in Wamsutter, which may gain in

temporary short-term population during the construction of two interstate pipelines and the development of a worker housing facility by BP America (See chapter 5 for a discussion of potential cumulative effects).

Housing Effects

First year and peak-year housing demand associated with the Proposed Action is displayed in table 4-14. Non-local temporary workers are anticipated to share housing at a rate of two workers per unit. For longer term housing demand, it is anticipated that every household would include an average of 1.2 workers and have an average size of 2.5 persons, the average size of Wyoming households identified by the 2000 U.S. Census (U.S. Census Bureau 2004).

As with population, it is important to note that the housing demand does not include housing currently occupied by existing workers whose employment would be supported by Proposed-Action-related activities.

Table 4-14. First Year and Peak-Year Proposed Action-Related Housing Demand.

	Proposed Action-Related Housing Demand by Community					
	Rawlins		Little Snake River Valley		Wamsutter	
	1st Year	Peak Year	1st Year	Peak Year	1st Year	Peak Year
Temporary	181	181	23	24	23	23
Longer Term	125	170	16	21	16	21
Total	306	351	39	45	39	44

Prepared by: BCLLC

Based on the housing inventory contained in section 3.12, the Proposed Action-related increment of demand for both short-term and longer-term housing would likely strain or exceed currently available resources in all communities within the analysis area when coupled with demand from other gas development projects.

Based on capacity, the motels, recreational vehicle parks, and mobile home parks could adequately accommodate demand from temporary workers. However, competition from cumulative natural gas development would likely create the need for temporary dormitory housing depending on the level of activity occurring at the time (See chapter 5 for a discussion of cumulative housing demand). It is becoming increasingly common for drilling and gas field service companies to provide mobile dormitory units for temporary workers. Such units add to a community's temporary housing resources without creating an oversupply of units when drilling and field development are completed.

A portion of the longer-term population associated with the Proposed Action could be accommodated in mobile home parks in Rawlins. However, demand from other projects may cause competition for these resources. Rawlins has some currently unused pads in mobile home parks and may initially attract both temporary and longer-term workers. Rawlins might also attract these workers because much of the initial development would likely occur in the central and northern parts of the ARPA. Longer-term workers may relocate to Little Snake River Valley and Wamsutter, as development moves to the southern portion of the ARPA.

Longer-term housing availability is currently tight in both Wamsutter and the Little Snake River Valley. The longer tenure of the relatively small increment of housing demand would allow time for local housing markets to respond to demand for rental or owner-occupied housing units. But it may be that some Proposed-Action-related workers would initially seek housing resources in mobile home parks in Rawlins and either wait for housing to become available in the Little Snake River Valley or Wamsutter or contract for development of new housing.

Effects on Community Services

As discussed in section 3.12, most community facilities in Carbon County and the communities near the ARPA were developed for a substantially larger population than currently exists. As a result, the population increase associated with the Proposed Action could be readily accommodated by most existing community facilities and schools. The enrollment increment in Rawlins could strain the elementary school capacity if Proposed-Action-related enrollment was concentrated in the lower grades. However, enrollment would be adequate if evenly distributed due to the excess capacity in the middle and high schools. In addition, Rawlins should have a new elementary school and should have completed remodeling of the middle school by the time the peak year occurs.

The additional water supply that the recently completed High Savery reservoir provides to Baggs, Wyoming, would accommodate the relatively small population increment projected for that community. A new Carbon County jail has recently been completed, which should alleviate inmate overcrowding, at least for the near term. Some project-related tax revenues associated with the Atlantic Rim pods would be available to offset increased service demand. However, there would be a several-year lag before substantial Proposed-Action-related revenues flow because ad valorem property taxes would provide the largest source of project-related revenue. Given recent increases in natural gas production from other fields and elevated natural gas prices, Carbon County and affected special districts may have substantial revenues to address the increase in service demand associated with the Proposed Action until production-related revenues begin to flow.

Law enforcement, emergency response (fire suppression and ambulance), and county roads are the local government services most likely to be affected during the annual 6-month drilling and field development season. As demonstrated below under Fiscal Effects, Carbon County would receive substantial revenues to help support increased demand for these services over the life of the project.

Although demands on local government facilities and services in Rawlins is anticipated to be moderate and demands in smaller municipalities, minimal, communities would receive few direct revenues from Proposed-Action-related development or production. Therefore impacts that result in demand for new infrastructure or services are unlikely to be offset by Proposed-Action-related revenues. Wamsutter is located in Sweetwater County and would therefore receive no project-related tax revenues, except a small portion of severance tax revenues distributed to local governments throughout the state.

Fiscal Effects

The Proposed Action would generate substantial tax revenues including:

- Local ad valorem property taxes on production and certain field facilities;
- Sales and uses taxes on materials, supplies, and equipment;

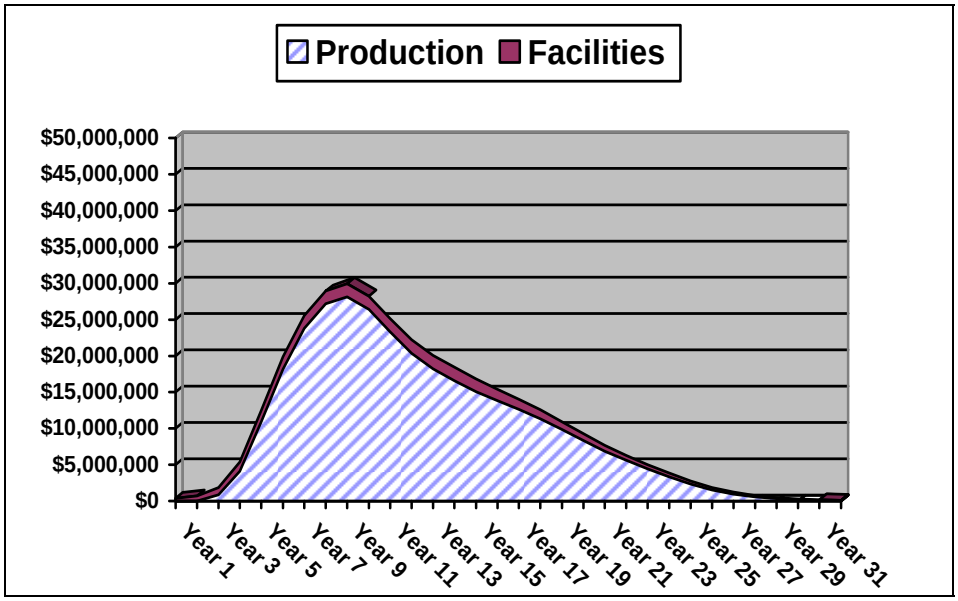
- Federal and state mineral royalty payments; and
- Wyoming state severance taxes.

Ad Valorem Property Taxes. The Proposed Action would generate ad valorem property tax to Carbon County, the Wyoming School Foundation Fund, Carbon County School District #1, and a number of special taxing districts. Direct ad valorem property taxes would be generated from two sources: (1) the value of natural gas produced and sold and (2) the value of certain well field and production facilities (underground facilities associated with wells are exempt). Indirect ad valorem tax revenues may be generated by the infrastructure investments made by gas service companies and vendors that expand facilities as a result of the incremental economic activity. Long-term employees of gas companies and vendors may purchase new properties or improve existing properties generating additional property taxes. Potential indirect revenues have not been estimated for this assessment.

Constant 2003 mill levies were used to prepare property tax estimates. The Wyoming School Foundation Program and shared county school mill levies are set by statute. Other mill levies are set each year by the county commissioners and officials of the various taxing districts within limits imposed by the state legislature; some change each year. Mill levies reflect the revenue needs of the taxing entity and estimates of assessed valuation within the entity. Natural gas is assessed based on the previous year's production. Well field facilities are depreciated after the first year of production.

Figure 4-13 displays annual Proposed-Action-related ad valorem property tax estimates based on the assumptions outlined earlier and assuming a constant total mill levy of 62.85 mills. Table 4-15 displays estimated ad valorem property tax revenues to major property taxing entities in Carbon County. Under the inputs and assumptions used for this assessment, ad valorem property tax revenues from production and facilities would total $349 million over the 32-year life of the project or an annual average of almost $11 million.

Figure 4-13. Proposed Action-Related Ad Valorem Property Tax Estimates.



Prepared by: BCLLC

Carbon County and certain special districts would receive approximately $96 million over 32 years under the assumptions used for this assessment. Note that some affected special districts only cover part of the ARPA; therefore an average of special district levies has been used for the assessment.

Table 4-15. Estimated Proposed Action-Related Ad Valorem Property Tax Revenues: Carbon County and Affected Special Districts.

	County (12 mill)	Weed & Pest (1 mill)	Recreation (1mill)	Conservation Districts (1 mill)	Avg. Total Special Districts (2.35 mill)	Total County & Special Districts
Total (32 year)	$66.6 million	$5.6 million	$5.6 million	$5.6 million	$13 million	$96 million
Average Annual	$2.1 million	$173,000	$173,000	$173,000	$408,000	$3 million

Note:
Table does not break out all special districts. Columns may not sum due to rounding.
Prepared by: BCLLC

Table 4-16 displays Proposed-Action-related revenues that would accrue to local schools and to the Wyoming School Foundation Fund. A portion of the revenue collected under the School District U-1 26.5 mill levy would accrue to the Wyoming School Foundation Fund because the district is a "recapture" district under the provisions of the School Foundation Program. Recapture means that revenues above a certain level are collected by the state for redistribution to other school districts (See chapter 3). District U-1's budget could increase as a result of student enrollment increases associated with Proposed-Action-related, longer-term population.

Table 4-16. Estimated Proposed Action-Related Ad Valorem Property Tax Revenues: Carbon County School District #1 and Other School Entities.

	School Dist. U1 (26.5 mill)*	State School Foundation Fund (12 mill)	County School (6 mill)	BOCES (1 mill)	Total Schools
Total (32 year)	$147 million	$66.6 million	$33.3 million	$5.6 million	$252.6 million
Average Annual	$4.6 million	$2.1 million	$1 million	$173,000	$7.9 million

Notes:
*****Much of the revenue associated with District U1 levy is likely to accrue to the Wyoming School Foundation Fund. Columns may not sum due to rounding.
Prepared by: BCLLC

It should be noted that mill levies that produce revenues in excess of expenditures are frequently reduced. The potential for reduced mill levies in Carbon County is high given anticipated increases in both production and gas prices. Reduced mill levies would result in reduced taxes for property owners and other commercial and industrial interests in the county.

Federal and State Mineral Royalties and Wyoming Severance Taxes. 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 the 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. It is difficult to predict with certainty where all CBNG wells within the ARPA would be located. For this assessment, it is assumed that 64 percent of the CBNG associated with the Proposed Action would be produced from federally owned minerals, 31 percent would be produced from privately owned minerals, and 5 percent would be produced from state-owned minerals. As noted above, production associated with conventional wells has not been estimated for this assessment.

The State of Wyoming collects either a 16.67 percent or a 12.5 percent royalty on natural gas produced from state-owned minerals, depending on the circumstances of the lease. For this assessment, state mineral royalties were assumed to be 12.5 percent.

The State of Wyoming collects a 6-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 distributes revenues from this fund to a variety of accounts including the General Fund, Water Development Fund, Mineral Trust Fund, and Budget Reserve. It also distributes a fixed 1 percent of the revenues to counties and municipalities.

Estimated mineral royalty and severance tax revenues are displayed in table 4-17. Actual mineral royalty and severance tax revenues would vary based on production levels, well locations, gas sales prices, and actual production and transportation costs. Actual severance tax revenues may be less than these estimates if a portion of the gas is used for production purposes.

Table 4-17. Federal Mineral Royalty and Wyoming Severance Tax Estimates.

	40-Year Total	Average Annual
Federal Mineral Royalties	$320 million	$10 million
Wyoming Share of Federal Mineral Royalties	$160 million	$5 million
Wyoming State Mineral Royalties	$8.4 million	$264,000
Wyoming Severance Taxes	$271 million	$6.8 million

Note:
Columns may not sum due to rounding.
Prepared by: BCLLC

Sales and Use Tax. Wyoming collects a 4-percent sales and use tax on the gross receipts of sales of tangible goods and certain services (drilling services are exempt). The state returns 31 percent of the revenue (less administrative costs) to the county where the taxes were collected. Counties distribute the revenues to incorporated municipalities based on population. As a local option, Carbon County also collects a 1-percent, general-purpose sales and use tax,

which is distributed to the county and its municipalities, and a 1-percent dedicated sales and use tax for capital facilities.

Table 4-18 displays the estimated state and local revenues that would flow from expenditures made during the drilling and field development phase of the Proposed Action, assuming that all sales and use tax payments are appropriately credited to Carbon County. Total sales and use tax revenues over the 20-year drilling cycle would be $17.2 million dollars. Of the total, an estimated $9.5 million would be distributed to the State of Wyoming and $7.7 million to Carbon County and its municipalities. In addition, the Proposed Action would contribute 1 percent of taxable sales until the current local option facilities tax expires (these revenues have not been estimated).

Table 4-18. Estimated Sales and Use Tax Revenues and Distributions.

State of Wyoming						
Total	$5.4 million					
Average Annual	$271,000					
	Carbon County Total	**County Share**	**Rawlins**	**Baggs**	**Dixon**	**All Other Towns**
Total	$4.4 million[1]	$623,000	$2.5 million	$98,000	$22,000	$1.1 million
Average Annual	$220,000	$31,000	$127,000	$4,900	$1,100	$56,000

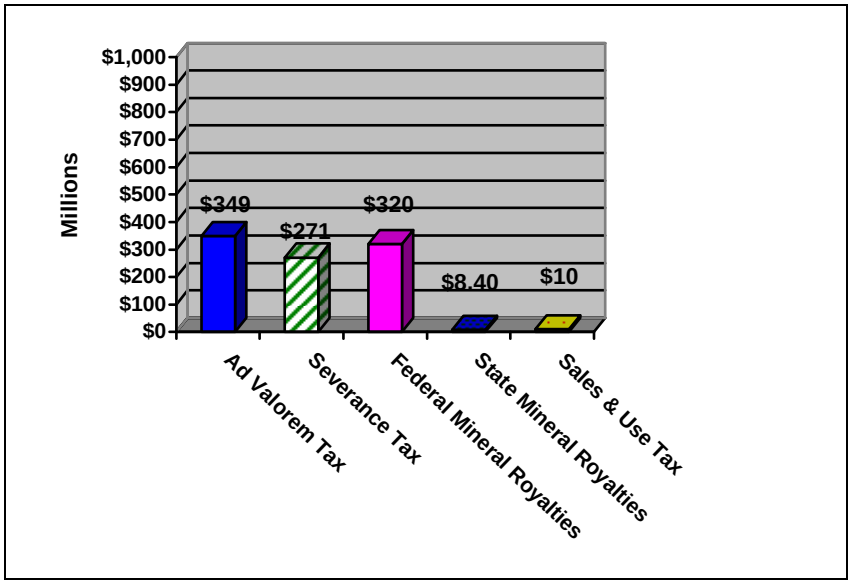
Notes:
Columns may not sum due to rounding.
[1]Excludes proceeds from 1 percent local option facilities tax.
Prepared by: BCLLC

Total Revenues. Figure 4-14 summarizes the estimates of the main tax and royalty revenues attributable to the Proposed Action. The revenues are based on production, gas sales prices, tax rates, and exemption estimates, all of which are subject to change as development proceeds. In addition to these revenues, other revenues would be associated with the Proposed Action including sales and use tax payments for ongoing operations of the project and from employee and vendor spending, Oil and Gas Conservation charges, and federal income tax payments by the proponent and its employees. These revenues have not been estimated for this assessment.

Local Attitudes, Opinions, and Lifestyles

The Proposed Action has the potential to affect local attitudes, opinions, and lifestyles in two ways. Affected communities would experience change related to the increase in economic activity, employment, and population growth associated with natural gas development. The Proposed Action also has the potential to affect ranchers, who own land in the ARPA, and users of the project area, such as grazing operators, outfitters, hunters, and other recreationists.

Figure 4-14. Total Ad Valorem Property Tax, Federal Mineral Royalty, Severance Tax, and Sales and Use Tax Revenues Associated with the Proposed Action.



Prepared by: BCLLC

Carbon County has a relatively long history of oil and gas development. Consequently, residents are familiar with natural gas industry activities and their economic benefits. The combination of familiarity and anticipated economic benefit creates a climate of general community acceptance of and support for continued natural gas development in Carbon County, particularly in Rawlins and the Little Snake River Valley. Because the economy of Carbon County has generally declined since the early 1980s due to closure of several coal mines and problems in the timber industry, many residents of Carbon County and Rawlins welcome the current economic expansion resulting from natural gas development (Kilgore 2004 and Grabow 2004). Rawlins in particular has unused public and commercial infrastructure that could be redeveloped to accommodate population growth.

Within this general climate of acceptance, some residents have attitudes and values that may diminish support or create opposition for a particular development proposal. These attitudes and values include concern for use of public lands and preservation of wildlife habitat and recreation resources.

These attitudes and values are evident in a number of the comments submitted during the scoping process and comments received to the draft EIS. In addition, a discussion of these attitudes and values, as expressed by Carbon County residents, is included in the findings of the 1996 resident survey conducted for the Carbon County Land Use Plan (discussed in section 3.12).

According to the Carbon County Land Use Plan, resident response to the survey suggests “a need to balance the conservation of natural resources and the economic viability of resource-based industries in the county.” Residents also showed partial support for leasing more federal lands for oil and gas development (about 50 percent countywide). These two opinions suggest that development of natural gas resources on existing leases could be generally supported by

residents of Carbon County, as long as they perceive that such development does not damage wildlife habitat or degrade the quality of recreation resources in the area.

The groups that would be most directly affected by the Proposed Action have mixed feelings about the development. These groups include some landowners, grazing operators, and outfitters within the ARPA. While most support resource development on public lands and believe development of natural gas resources within the ARPA is in the national interest, some are concerned about the potential effect on their operations, about changes in the relatively undeveloped landscape and about effects to their traditional way of life (Carrico 2005, Hansen 2004, Hicks 2004, Montgomery 2004 and O'Toole 2004).

Members of this group have expressed some or all of the following concerns:

- Fragmentation of the landscape, grazing lands, and wildlife habitat caused by gas field roads, well pads, and infrastructure;
- Disruption of grazing operations;
- Soil erosion from disturbance and the potential effects of erosion on streams and stock ponds;
- The potential for encroachment of weeds on disturbed land, particularly since the recent drought has weakened and killed some native plants;
- The increased potential for trespass and damage to private lands and improvements given the increased access that well field roads would provide;
- Affects on big game (many ranchers also have outfitting operations on their lands or lease lands to outfitters and hunters); and
- The potential that the operators may seek more dense well spacing in the future, further increasing the potential for each of the above identified impacts.

Other sections of this assessment analyze potential impacts to range resources, noxious and invasive species, wildlife, wildlife habitat, and a variety of measures to mitigate these impacts are either committed or proposed. Some ranchers and grazing operators are concerned that mitigation measures for these identified impacts would not be rigorously enforced or effective.

But even if mitigation measures are enforced and effective, some ranchers and grazing operators believe that the Proposed Action would change the current relatively undisturbed character of much of the rangeland/wildlife habitat within the ARPA. The effect would be to introduce or expand resource extraction, a type of low-density industrial use, which would in turn alter their traditional use and way of life.

Based on these observations, it is likely that the Proposed Action would receive general support in Carbon County communities, but individual members of specific groups with interests and concerns more directly affected by the Proposed Action could experience varying degrees of dissatisfaction with the change in use of the land.

Environmental Justice

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).

Environmental Justice includes impacts to air, water, or other environmental values or health and safety risks that are experienced disproportionately by minority or low-income populations. As noted in section 3.12, there are no human populations located within the ARPA. There are no residences within the ARPA that are occupied year round, although some residences on ranches are temporarily or seasonally occupied. The ARPA is relatively distant from population centers, so no populations would be subjected to direct physical impacts from the Proposed Action. Therefore the Proposed Action would not directly affect the health and safety of any minority or low-income populations, nor would it directly affect their social, cultural, or economic well being.

However, the Proposed Action could result in increased incomes for low-income populations living in communities near the ARPA area. The Proposed Action would create or sustain an annual average of 578 jobs (AJEs) over the 13-year drilling and field development phase of the project, and an annual average of 161 jobs during the production phase of the project. These direct, indirect, and induced employment opportunities would occur in all sectors of the economy and provide additional job opportunities for unskilled, low-income residents, as well as those that might become skilled through local training programs. The increased labor demand would have the likely effect of reducing unemployment in the county and increasing labor force participation, two factors that could also increase incomes.

While in many cases skilled workers would be imported to the area to fill skilled and specialized labor demand, the availability of local unemployed or underemployed individuals would offer the companies the opportunity to retain workers who are already located and housed within the area. The applicant-committed measure to “Implement hiring policies that would encourage the use of local or regional workers who would not have to relocate to the area” should enhance this opportunity.

Employment of local unemployed or underemployed individuals for skilled or specialty occupations would require training and development, generally in a trade school or institution of higher education. Post high school training in Carbon County is currently offered by the Carbon County Higher Educational Center. Management, administrative, technical, and trade-related training and certification opportunities are offered including some energy-industry-specific courses and certifications. Some courses qualify for college credit and can lead to college degrees or trade certifications. The opportunity for post-high school level education for both blue collar and white collar jobs within Carbon County could provide opportunities for low-income residents to obtain and benefit from skilled and specialty employment locally.

4.12.3.2 Alternative A (No Action)

Under Alternative A, the community would not experience the effects of the Proposed Action described in section 4.12.3.1. Some local residents who may have benefited economically from the proposed development might be dissatisfied with the forgone opportunities.

4.12.3.3 Alternative C

Under Alternative C it is assumed that the operators would propose to drill an equivalent number of wells each year as assumed under the Proposed Action (section 4.12.3.1). Although development protection measures could limit the number of allowable well locations within certain areas of the ARPA, the operators would have options for avoiding or mitigating impacts that could be employed to avoid some well reductions. It is anticipated that fewer wells would ultimately be drilled under Alternative C, but actual determinations would not occur until individual well sites would be proposed. Therefore the actual number of wells allowable under Alternative C has not been estimated, but would likely be less than the Proposed Action.

Economic Effects

Economic effects of Alternative C would be anticipated to be similar in kind to those associated with the Proposed Action, but reductions in economic effects would likely occur because fewer wells would be drilled as a result of development protection measures. Similarly, changes in production levels or operating costs associated with development protection measures would result in different economic effects than those associated with the Proposed Action.

Under this alternative, construction and development constraints could arise where resources exist or overlap. Where development protection measures are applied, natural gas extraction could be constrained, potentially leaving unextracted natural gas resources in the ground and causing correspondingly increased relative construction and operations costs and decreased revenues. Limited operating periods would affect the timing of development and could affect the intensity and cost of construction activities by focusing them into tighter construction windows.

Alternative-C-Related Effects on other Economic Activities within the ARPA

Under Alternative C, economic effects to ranchers, grazing operators, outfitters, hunters, and other recreation visitors would be similar to those associated with the Proposed Action except that development protection measures that reduce impacts to resources could also result in fewer adverse economic effects.

Given the substantially smaller area of disturbance associated with Alternative C, it is less likely that grazing operators whose allotments are concentrated within the ARPA would chose to forgo use of the allotment or it is possible that they would forgo use of a portion of the allotment rather than the whole allotment. Still, if these grazing operators could not find comparable grazing lands within the county at comparable costs, or if they chose to forgo grazing entirely for one or more seasons, the economic impact associated with that operator's reduction in AUMs would be forgone for the period of nonuse.

Employment and Population Effects

Employment effects of Alternative C would be similar to those associated with the Proposed Action. However, drilling and field development activities could intensify within a tighter window in response to development requirements associated with development protection measures. Drilling activities could also diminish if fewer wells were ultimately drilled under these restrictions. These effects to drilling and field development would have equivalent effects on employment. Conversely, employment effects could be reduced as compared to the Proposed Action if fewer wells were actually drilled because of development protection measures.

Population effects of Alternative C would be similar to those identified under the Proposed Action. Differences could occur related to the employment effects identified above.

Housing Effects

Housing effects of Alternative C would be similar to those identified under the Proposed Action. Differences could occur related to the employment and population effects identified above.

Effects on Community Services

Demand for community services related to Alternative C would be similar to those identified under the Proposed Action. Differences could occur related to the employment and population effects identified above.

Fiscal Effects

Fiscal effects of Alternative C would depend on the number of wells actually drilled under Alternative C. Production-related property, severance taxes, and federal mineral royalties would be reduced if fewer wells were allowed under development protection measures. Increased operations cost could also reduce federal mineral royalty, state severance tax, and county ad valorem property tax revenues on production.

Local Attitudes, Opinions, and Lifestyles

Effects on local attitudes, opinions, and lifestyles associated with Alternative C would be similar to those associated with the Proposed Action. However, ranchers, grazing operators, outfitters, hunters, and other recreation users could be less likely to experience dissatisfaction with the changes to the relatively undisturbed landscapes in certain portions of the ARPA due to a reduction in development.

Environmental Justice

Environmental justice for Alternative C would be the same as the Proposed Action.

4.12.3.4 Alternative D

Under Alternative D, it is assumed that the operators would propose to drill an equivalent number of wells each year as assumed under the Proposed Action. The actual number of wells drilled would be dependent on the operators' ability to stay within the disturbance limits associated with Alternative D while maintaining the anticipated pace of drilling and field development.

The differences in socioeconomic effects between Alternative D and the Proposed Action would therefore be related to the actual number of wells drilled as contrasted with the level of drilling assumed on figure 2-1. If the operators are unable to maintain the pace of drilling and stay within the prescribed disturbance limits, the socioeconomic effects described for the Proposed Action would be reduced proportionately to the reduction in drilling levels. Over time, however, it is likely that the same number of wells would be drilled as under the Proposed Action, but the pace of drilling would be slower and perhaps spread more evenly across the 20-year drilling and field development period to accommodate the pace of reclamation. Consequently socioeconomic effects would be reduced in the early years of the 20-year drilling schedule compared to the Proposed Action, but higher in later years, possibly resulting in a more-constant and sustained level of drilling during the 20-year period.

Economic Effects

Economic effects would be similar to those described for the Proposed Action to the extent that the operators are able to maintain the same pace of drilling. Increased drilling and well development costs would be likely as operators implement more costly measures to reduce initial disturbance and implement more intensive reclamation activities. These measures are likely to result in higher drilling and field development employment levels and correspondingly higher labor costs for the operators.

If the operators were unable to maintain the pace of drilling outlined on figure 2-1, the magnitude of economic activity, employment, and earnings would be lower on an annual basis in the early years and higher in later years, but spread more evenly across the 20-year period.

Leaseholders would experience delays in revenues as compared with the Proposed Action if actual annual drilling rates were lower under Alternative D. Otherwise, leaseholder revenues would be similar to those associated with the Proposed Action.

Alternative-D-Related Effects on other Economic Activities with the ARPA

The lesser amount of unreclaimed disturbance associated with Alternative D would be anticipated to generate fewer and less-intensive effects for both grazing operators and recreation users of the ARPA, as contrasted to the Proposed Action. This would include:

- A smaller reduction in AUMs resulting from loss of forage associated with disturbance,
- Possible lesser reductions in wildlife habitat,
- Changes in setting resulting in less displacement of hunters, and
- Fewer impacts to landowners, outfitters, and local businesses that serve hunters.

However, some impacts on grazing operators and recreation users would still be anticipated.

Employment, Population, Housing, Community Services, and Fiscal Effects

Effects on these socioeconomic aspects associated with Alternative D are dependent on the actual pace of drilling and field development. If operators maintained the drilling rates on figure 2-1, these effects would be similar to the Proposed Action. Conversely, lower annual drilling rates would cause lower effects in the early years of drilling and field development and higher effects in later years, potentially moderating the effects across the life of the project.

Under Alternative D, drilling and field development employment levels could be higher to account for differences in techniques needed to minimize disturbance and perform more-intensive reclamation activities.

Local Attitudes, Opinions and Lifestyles

Under Alternative D, rates of drilling similar to those outlined on figure 2-1 would be anticipated to result in similar effects on local attitudes, opinions, and lifestyles as described for the Proposed Action. However, lower disturbance levels would be anticipated to result in lesser impacts on grazing operators and recreation users of lands within the ARPA and possibly result in lower levels of dissatisfaction among some members of those groups.

Environmental Justice

Environmental justice effects of Alternative D would be similar to those associated with the Proposed Action. Because no environmental justice populations would be directly affected by Alternative D, no adverse environmental justice impacts are anticipated. If employment levels were lower as a result of the inability of the operators to maintain the anticipated pace of drilling and stay with in disturbance limits, fewer employment opportunities would be available for low income residents of the study area. However, given the anticipated higher levels of drilling and field development anticipated for later years, employment opportunities for low-income residents could be more sustained.

4.12.4 Impacts Summary

Economic impacts of natural gas development and production would result in increased revenues and income under the Proposed Action and Alternatives C and D. Based on the assumptions used for this assessment, natural gas development would enhance regional economic conditions and generate substantial local, state, and federal tax and royalty revenues. Economic benefits would be similar in kind for the Proposed Action and Alternatives C and D. Economic and fiscal impacts would likely be reduced under Alternative C because it is likely that some development would be precluded from specific areas as a result of development protection measures, which would reduce the economic and fiscal effects of both development and production. Income to leaseholders would also likely be less under Alternative C.

As discussed above, differences between Alternative D and the Proposed Action would depend on the ability of the operators to maintain the drilling schedule outlined on figure 2-1 and stay within allowable disturbance limits. If the anticipated pace of drilling is maintained, fewer wells would be drilled in the earlier years and more drilled in later years compared to the schedule on figure 2-1. This circumstance would result in more moderate and sustained socioeconomic effects on local communities.

Natural gas-related economic benefits may be diminished slightly by reductions in grazing, hunting, and other recreation activity in the project area under all of the alternatives. Individual landowners and outfitters within the ARPA could experience economic losses associated with reductions in hunting activity. For individual land owners and outfitters, these losses could range from minimal to substantial depending on the location, development in relation to a specific property, the timing of development, actual effects on big game and big game habitat, the duration of effects, and the success of mitigation measures. Businesses in the Little Snake River Valley that provide goods and services to hunters could also experience reductions in income from reductions in hunting activity. For many of these businesses, reductions in hunting activity would be offset by increases in drilling and field development activity.

For all action alternatives, the population increment associated with drilling and field development coupled with cumulative drilling and field development activities would likely strain existing housing resources. The relatively small in-migrant population increment anticipated for communities in the Little Snake River Valley and Wamsutter could be accommodated by existing community infrastructure. Project-related sales tax, use tax, and property tax revenues would offset project-related demand for local government services in Carbon County, although revenues may lag demand in the early years of the project. Rawlins and the communities in the Little Snake River Valley would receive minimal direct tax revenues from natural gas development. Wamsutter would receive no direct revenues, except for a relatively small portion of mineral royalties and severance taxes.

Community acceptance of natural gas development would be mixed under all of the alternatives. Many residents would support the development, but some land owners, grazing operators, outfitters, hunters, and other recreational users of the ARPA are likely to experience varying degrees of dissatisfaction with the change in land use and the change in character of lands within the ARPA.

4.12.5 Additional Mitigation Measures

The economic and employment effects of all three action alternatives would be substantially increased revenues and income. The operator-committed policy of hiring local workers, to the extent that such workers are available, would enhance local economic and employment effects and reduce demand for housing and community services.

The operator-committed policy of coordinating project activities with ranching operations would minimize conflicts involving livestock movement or other ranch operations. Some aspects of the policy that would reduce conflicts and dissatisfaction among these land users include:

- Scheduling of project activities to minimize potential disturbance of large-scale livestock movements,
- Establishing effective and frequent communication with affected ranchers to monitor and correct problems, and
- Coordinating scheduling.

When coupled with cumulative demand, rig and construction camps for project workers might be necessary, as project-related demand for both temporary and longer-term housing is likely to strain or exceed existing housing resources in all area communities. Development of these camps would also free up spaces in mobile home parks in Rawlins, which could be used by longer-term workers until the local housing market is able to respond to longer-term demand.

During the interim drilling period, the BLM RFO has initiated a transportation planning process with representatives of directly affected interests including the BLM, WGFD, Carbon County, the LSRCD, and the operators. Although initially intended to address transportation issues, it has emerged as a forum for identifying and addressing existing and potential development issues and opportunities. As this process evolves and matures, it has the potential for reducing conflict and dissatisfaction with CBNG development in the ARPA.

4.13 Transportation

4.13.1 Introduction

This section identifies potential effects of the proposed project on the transportation system that would provide access to the ARPA, as well as the road network within the ARPA. This system would include federal and state highways, CCRs, BLM roads, private roads, and operator-maintained roads. Potential effects of new and improved roads within the ARPA on soils, noxious and invasive species, range resources, wildlife habitat, recreation resources, and visual resources are described in sections 4.3, 4.5, 4.6, 4.7, 4.9, and 4.10, respectively.

4.13.2 Impact Significance Criteria

The Great Divide RMP (USDI-BLM 1990) and state (WSLUC 1979) land use plans prescribe the following management objectives associated with transportation resources:

- To support the goals and objectives of other resource programs for managing the BLM-administered public lands and to respond to public demand access for land use authorizations.

The following criteria are used to determine whether transportation impacts would be significant and represent a balance between public access and transportation safety:

1. Substantial limitation on public access to travel with the ARPA;

2. Substantial reduction in opportunity for acquisition of access easements and road development; and

3. Increases in traffic levels on the local public transportation system that would cause the level of service on the system to fall below acceptable levels, as defined by the responsible government agency.

4.13.3 Direct and Indirect Impacts

4.13.3.1 Proposed Action

Highways and Roads Providing Access to the ARPA

Transportation effects of natural gas development and production would include increased traffic on federal and state highways and county roads providing access to the ARPA, primarily I-80, WY 789, WY 70, CCR 605N, and CCR 608 (map M-33). Depending on the outcome of the Coordinated Transportation Planning process described below, traffic could also increase on CCR 501, CCR 503, and BLM Road 3309 (map M-33).

Although access from WY 71 on the east side of the ARPA is possible from several CCRs, there are no communities in that area. Consequently, few trips would originate from areas served by those routes.

Most traffic accessing Pods 1–4 (Red Rim, Jolly Roger Alpha and Beta, and the currently dormant Pod #1) would travel on CCR 605N. Trips originating in Rawlins would access CCR 605N southwest of Rawlins. Trips originating in Rock Springs or Wamsutter would travel I-80 east to CC 605N. Trips originating in the Little Snake River Valley are likely to travel WY 789 north and I-80 east to the CCR 605N entry point.

Traffic accessing Pods 5–9 (Doty Mountain, Sun Dog/Cow Creek, Blue Sky, Brown Cow, and Muddy Mountain) are likely to use CCR 608, which enters the ARPA east of Dad. Trips originating in both Rawlins and Rock Springs would travel I-80 west to WY 789 south to Dad. Trips originating in Wamsutter would use SCR 23/CCR 701 (the Wamsutter/Dad Road) east and trips originating in the Little Snake River Valley would use WY 70 west to WY 789 north, entering CCR 608 at Dad. Some trips originating in the Little Snake River Valley destined for the Muddy Mountain Pod may enter the ARPA from the south, using CCR 503 or CCR 501. However, the operators intend to establish primary access from CCR 608 and develop a new

road or improve existing roads from the north to provide access to the Muddy Mountain Pod. CCR 503, which passes through Cottonwood Canyon north of Dixon, is a narrow winding road that passes through areas with important resources values. CCR 501 is minimally improved in its upper reaches and would require substantial improvement to serve as a primary access point from the south. These factors and the fact that most ARPA traffic will originate in communities to the north would discourage heavy use of these roads for project access.

Access to the southwestern portion of the ARPA is possible using BLM 3309; however, this road is only minimally improved and crosses critical wildlife habitat. Both the BLM and the operators intend to develop policies to discourage use of this road for project access.

Table K-2 (appendix K) shows the estimated average number of trips associated with drilling, field development, and well field operations activities. Drill rigs and certain other items of heavy equipment would be transported to the ARPA and remain within the project area until their relevant work is completed. Materials and supplies would be delivered on an as-needed basis. Drilling and completion crews would commute to ARPA daily. Other contractors and vendors would commute on an intermittent, as-needed basis.

AADT estimates were developed based on a simulation of drilling activities for typical CBNG and conventional wells, construction of ancillary facilities, performance of routine operations activities and well workovers, and consideration of miscellaneous visits. Based on the results of the simulation, the Proposed Action would generate an estimated AADT of 419 (210 round trips) during the peak drilling year (Year 5). This would include an AADT of 254 for drilling and field development activities. Note that AADT is calculated on a 365-day basis and drilling and field development activities would be limited to 6 months out of each year. As such, average daily traffic would be substantially higher during the active drilling period for about 490 trips or 245 round trips per day.

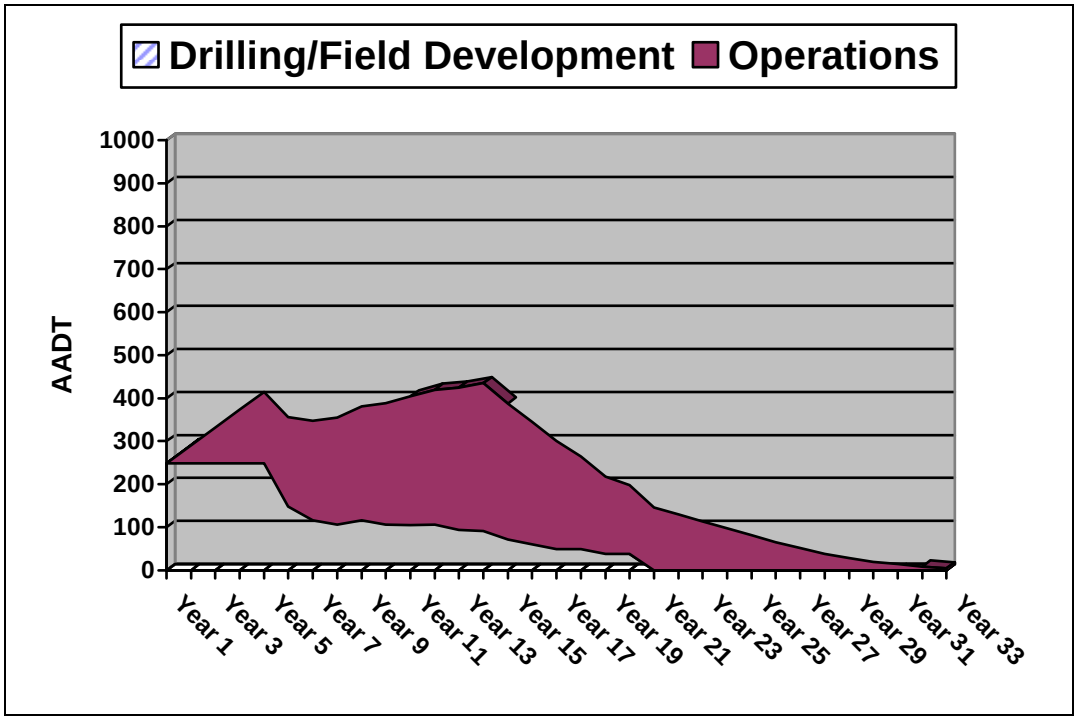
During the peak drilling year, AADT for well field operations would be an estimated 165 (83 round trips) for 840 producing wells. In subsequent years, drilling and field development traffic would diminish, but operations traffic would increase as more wells come into production until 2025 when wells would begin to come off-line under the assumptions used for this assessment (See figure 4-15). Under the assumptions used for this assessment, Proposed-Action-related AADT would be in the 350 to 430 range for about 20 years. Traffic volumes could be reduced substantially by implementation of wellhead telemetry systems.

Table 4-19 contrasts peak drilling year (Year 5) AADT for federal and state highways providing access to the ARPA with 2002 and projected 2012 AADT. Proposed-Action-related peak drilling year AADT would total:

- Two percent of 2002 AADT on I-80,
- Twenty-eight percent of 2002 AADT (51 percent of truck AADT) on WY 789, and
- Nine percent of 2002 AADT (63 percent of truck AADT) on WY 70.

Proposed-Action-related traffic during the peak drilling year would make up a slightly lower percentage of projected 2012 traffic except on WY 789, where base traffic is anticipated to decrease by 2012. However, given the potential for increased drilling and field development in the area, these traffic forecasts may change.

Figure 4-15. Proposed Action AADT Estimates, Drilling/Field Development and Operations: 2005–2044.



Prepared by: BCLLC

The Proposed-Action-related increase in traffic, particularly truck traffic, would accelerate maintenance requirements on federal and state highways. Wyoming severance tax revenues and the state's share of federal mineral royalty revenues associated with the Proposed Action would offset these costs. The Proposed-Action-related increase of traffic on federal and state highways would result in a corresponding increase in the statistical probability of accidents on these highways, although actual accident rates would depend on a variety of factors.

Table 4-19. Proposed Action Peak Drilling Year (Year 5) AADT Compared with 2002 AADT and 2012 Projected AADT on Affected Highways.

Highway	2002 AADT	Projected 2012 AADT	Estimated Peak Drilling Year AADT	% 2002 AADT	% Projected 2012 AADT
I-80 (Junction WY 789)	11,760 (6,460 trucks)	15,000	213 (96 trucks)	2% (1% trucks)	1%
WY 789 (Creston Jct. - Baggs)	860 (210 trucks)	800	240 (108 trucks)	28% (51% trucks)	30%
WY 70 (Dixon west)	480 (30 trucks)	550	42 (19 trucks)	9% (63% trucks)	8%

Table 4-20 displays estimated peak drilling year AADT on CCRs providing access to the ARPA. Although no current traffic counts are available for these roads, the estimated peak year traffic would be a substantial increase over pre-gas-development volumes.

As described in section 3.12, CCR 605N has been extensively improved by the Carbon County Road and Bridge Department to accommodate natural gas traffic. The estimated volume of traffic on CCR 605N would require a relatively high level of ongoing maintenance by the county.

Table 4-20. Proposed Action Peak Year (Year 5) AADT on Affected Carbon County Roads.

Carbon County Road	Peak Year AADT
CCR 605N (20 Mile Road)	184
CCR 608 (Wild Cow Road)	230
CCR 501 (Cherry Grove Road)	4

The Carbon County Road and Bridge Department plans to conduct extensive improvements to CCR 608 during 2005 to accommodate the high level of anticipated natural gas traffic. Although some ARPA road improvement projects have been conducted under a cooperative effort between Carbon County and the operators, the county has been required to fund improvements and increased maintenance activities in advance of substantial tax revenue flows from ARPA natural gas development. However, as described in section 4.12.3.1, Carbon County would receive substantial project-related ad valorem property taxes as production begins to flow.

Access within the ARPA

Currently, CCR 605N, CCR 608, and BLM Road 3305 serve as the transportation "spine" within the ARPA. Operator-constructed roads provide access from these roads to the pods. Based on the operators' estimate of an average of 0.5 miles of new roads per well, an initial total of 1,000 miles of new roads would be developed over the 20-year drilling and field development period. The operators would be required to construct new roads and improve existing roads to BLM standards, except in cases where roads cross private surface. Operators would also be required to maintain new and existing roads that access natural gas facilities within the ARPA.

Effects of the Proposed Action on the transportation network within the ARPA would include improved access and new access to portions of the ARPA for landowners, grazing operators, and recreation users. Potential effects would include impacts to important resource values. Portions of the ARPA are located in areas that contain sensitive resources. Construction of new roads or improvement of existing roads in these areas have the potential to impact those sensitive resources. However, certain mitigation measures would reduce these impacts: successful implementation of BLM road standards, RMP stipulations, operator-proposed mitigation measures, the preconstruction planning and site layout process, and the coordinated transportation planning process described in section 4.13.5.

The traffic associated with Proposed-Action-related drilling, field development, and operations would require substantial improvements on Carbon County and BLM roads used for access within the ARPA and would also accelerate maintenance requirements on existing, upgraded, and new roads. Exacerbating road maintenance factors include the unavoidable use of roads during wet and muddy conditions to maintain gas field facilities and excessive speed.

Carbon County would have substantial costs associated with improving and maintaining county roads for natural gas development and operations. The substantial revenues that would accrue to the county from natural gas production would offset these costs. However, Carbon County has and would expend funds for road improvement and maintenance in the ARPA before receiving substantial project-related revenues.

The increased traffic in the ARPA, particularly during the drilling and field development phase, would correspondingly increase the potential for vehicle/livestock accidents, conflicts with livestock operations, damage to range improvements (gates, cattle guards, etc.) during that period. These potential impacts are discussed in section 4.6.

4.13.3.2 Alternative A (No Action)

Under Alternative A, transportation effects would be limited to impacts associated with previously approved oil and gas development. No additional roads would be created, and traffic would be limited to trips necessary to develop and maintain production of existing wells associated with the Atlantic Rim pods.

4.13.3.3 Alternative C

Under Alternative C, it is assumed that the operators would propose to drill an equivalent number of wells each year as assumed under the Proposed Action. Consequently, transportation effects of Alternative C would be similar to those associated with the Proposed Action. However, under Alternative C, development protection measures could reduce the number of roads in portions of the ARPA with high environmental values as a result of rerouting roads to avoid such areas. Where development protection measures require rerouting of roads, limitations on disturbance, or other actions, additional road development costs and increased road construction times could occur. Specific effects from implementation of these measures would be identified in the anticipated ROD for the project during subsequent site-specific NEPA analyses.

To the extent that development protection measures resulted in a lesser number of wells being drilled in the ARPA, drilling, field development, and production-related traffic volumes would be correspondingly lower than those associated with the Proposed Action.

4.13.3.4 Alternative D

Under Alternative D, it is assumed that the operators would propose to drill an equivalent number of wells each year as assumed under the Proposed Action. Consequently, transportation effects of Alternative D would be similar to those associated with the Proposed Action. To the extent that the operators were unable to maintain the anticipated pace of development and remain within disturbance limits, the pace of development of resource roads would be correspondingly diminished and traffic volumes would also be correspondingly reduced. This could have the effect of extending length of time for both drilling, field development, and production. Under these circumstances, peak annual traffic volumes would be reduced, but the period during which both drilling- and production-related traffic would occur within the ARPA would be extended.

4.13.4 Impact Summary

Transportation effects of natural gas development and production associated with the Proposed Action and other action alternatives would include increased traffic on federal and state highways and county roads providing access to the ARPA. There would also be a statistical increase in the potential for accidents on these roads.

Transportation effects within the ARPA would occur on Carbon County, BLM, private, and operator-maintained roads. Operators would be required to construct new roads and improve existing roads to BLM standards, except in cases where roads cross private surface. Operators would also be required to maintain new and existing roads accessing natural gas facilities within the ARPA. All action alternatives would increase and improve access within the ARPA for ranchers, grazing operators, and recreation users. Conversely, development of new roads and improvement of existing roads result in higher road maintenance costs for Carbon County, offset by project-related revenues to the county.

4.13.5 Additional Mitigation Measures

In addition to the operator-committed measures, a coordinated transportation plan would be developed for the ARPA. A transportation plan would minimize construction of new roads, foster proper sizing of roads, and assign road maintenance responsibilities. The coordinated transportation process would include the BLM, the operators, Carbon County, WYDOT, the LSRCD, WGFD, private landowners, livestock operators, and other affected parties. The initial transportation planning effort would identify the most efficient and resource-sensitive locations for collector and local roads (existing roads would be used as collectors and local roads whenever possible to minimize the amount of surface disturbance within the area). In addition to development of new roads, the transportation plan would consider administrative closure and seasonal closure of existing roads, and the restriction of wellfield traffic on certain existing roads. The transportation planning process would also consider erosion prevention and minimization, prevention, and eradication of noxious and invasive species.

Transportation planning would continue to occur on an annual basis to:

- Assess ongoing effects on resource values;
- Identify the minimum road network necessary to support annual drilling and field development activities;
- Review and assign construction and maintenance responsibilities;
- Identify roads appropriate for abandonment and reclamation; and
- Identify fences, gates, and cattle guards which should be upgraded to accommodate heavy trucks and equipment.

Operator responsibilities for preventive and corrective maintenance of roads in the ARPA would extend throughout the duration of the project and include blading; cleaning ditches and drainage facilities; dust abatement; control of noxious and invasive species; maintenance of fences, gates, and cattle guards; and other requirements as directed by the BLM and private landowners.

4.14 Health and Safety

4.14.1 Introduction

Potential health and safety impacts associated with the action alternatives are similar to those associated with existing conditions in the ARPA. However, the risk of certain types of impacts would increase as the amount of natural gas development increases. Potential health and safety impacts include occupational hazards associated with oil and gas exploration and development, risk associated with vehicular travel on improved and unimproved roads, and range fires.

4.14.2 Impact Significance Criteria

No specific health and safety standards were identified in the Great Divide RMP. In general, health and safety effects of the action alternatives would be considered significant if they resulted in substantially increased risk to the public.

4.14.3 Direct and Indirect Impacts

4.14.3.1 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.

Occupational Hazards

The BLM, Occupational Safety and Health Administration (OSHA), USDOT, and Wyoming Oil and Gas Conservation Commission each regulate certain safety aspects of oil and gas development. The primary federal regulations related to health and safety requirements for oil and gas operations are specified under 43 CFR Ch. II, subpart 3162.5. These regulations require prior approval of a drilling and operations plan by the BLM. The plan addresses the procedures to be employed for protection of environmental quality including safety precautions, control and removal of waste, spill prevention, fire prevention, and fire fighting procedures. Adherence to relevant safety regulations on the part of the operators and enforcement by the respective agencies would reduce the probability of accidents. In addition, given the remote nature of the project area, and the relatively low use of these lands by others, 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 ARPA would increase the chance of a pipeline failure. However, pipeline hazards would result in minimal risk to public health and safety due to the low probability of failure, the remoteness of the project area, and the low level of anticipated non-project-related construction and excavation. Compliance with signing requirements for pipeline ROWs 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. A Hazardous Materials Management Plan is provided as appendix C. This plan was developed pursuant to BLM Instruction Memoranda Numbers WO-93-344 and WY-94-059, which require that all NEPA documents list and describe any hazardous or extremely hazardous materials that would be produced, used, stored, transported, or disposed of as a result of a proposed project.

Potential impacts associated with hazardous materials include human contact; inhalation or ingestion; and the effects of exposure, spills, or accidental fires on soils, surface water, groundwater resources, and wildlife.

The risk of human contact would be limited predominately to ARPA operator and contractor employees. A Hazard Communication Program, SPCC Plans, and other mitigation measures described in appendix H 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 4.13. Sanitation and hazardous material impacts would be avoided or reduced by the implementation of the mitigation measures outlined in appendix H.

The potential for firearms-related accidents would occur primarily during hunting season. The increased activity in the ARPA during drilling and field development would likely 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 project 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. 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 increase in risk to area fire suppression personnel associated with the Proposed Action.

There would be an increased potential for weather-related hazards associated with the Proposed Action. Many development locations in the ARPA are remote and rapidly moving storms can impair or preclude vehicular travel in a fairly short time. It is possible that workers may get stranded in remote locations requiring rescue operations by emergency management personnel. Proper training of development and operations workers, coordination with emergency management agencies, and frequent mapping of development locations can reduce the potential for weather-related impacts.

Based on the foregoing assessment, risks to public health and safety should not substantially increase as a result of the Proposed Action.

4.14.3.2 Alternative A (No Action)

Under this alternative, no incremental oil- and gas-related development would occur, so no additional effects to health and safety would occur for this alternative.

4.14.3.3 Alternative C

Under Alternative C, it is assumed that the operators would propose to drill an equivalent number of wells each year as assumed under the Proposed Action. Consequently, Alternative C health and safety effects would be the same as those associated with the Proposed Action. To the extent that fewer wells were drilled as a result of Alternative C, the probability of accidents would be lower than that associated with the Proposed Action.

4.14.3.4 Alternative D

Under Alternative D, it is similarly assumed that the operators would propose to drill an equivalent number of wells each year as assumed under the Proposed Action. Consequently, Alternative D health and safety effects would be the same as those associated with the Proposed Action. To the extent that the operators were unable to maintain the anticipated pace of development and remain within disturbance limits, the probability of accidents would be reduced proportionately to reductions in drilling and field development.

4.14.4 Additional Mitigation Measures

The operators should coordinate emergency response planning with the Carbon County Emergency Management Agency. They should also provide documentation regarding compliance with Federal Hazardous Material Regulations and the Uniform Fire Code. These mitigation measures, coupled with the measures outlined in appendix H, would be sufficient to mitigate risks to public health and safely.

4.15 Noise

4.15.1 Introduction

Noise associated with the action alternatives would be caused by machinery used during drilling, construction of pipelines and access roads, construction and operation of ancillary

facilities, drilling and production traffic including heavy trucks and related equipment, and compressor stations.

4.15.2 Impact Significance Criteria

The following criterion was used to assess the significance of noise impacts related to this project:

- Long-term activities that would exceed federal 55 dBA maximum standards for noise at either human- or animal-sensitive locations.

4.15.3 Direct and Indirect Impacts

4.15.3.1 Proposed Action

At specific locations within the ARPA, noise levels associated with drilling, field development, and operations activities may temporarily exceed the EPA threshold: average 24-hour noise level of 55 dBA. However, few persons other than employees would be affected by noise within the ARPA due to a lack of year-round-occupied human residences and the low level of human occupation within the project area.

Implementation of the Proposed Action has the potential to create noise-generated impacts that emanate from machinery used during drilling; 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 well workover operations.

Noise associated with natural gas drilling, field development, and field operations can affect human comfort and safety (at extreme levels). Noise impacts can also modify animal behavior (See section 4.7). 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. Under typical conditions, noise levels decline below the 55 dBA maximum standard at a relatively short distance (less than 1 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 project sites.

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 away. There are no year-round occupied residences located within the ARPA and residences occupied occasionally (during livestock operations) are located on private land. Locations of compressor stations on private

land would be determined in negotiations for surface use agreements. Therefore, field operations workers are likely to be the only group affected by compressor noise for other than brief periods of time.

Based on the foregoing and the noise mitigation measures contained in appendix E, noise impacts to the public associated with the Proposed Action would be minimal and short-term in nature.

4.15.3.2 Alternative A (No Action)

Under this alternative, there would be no incremental noise-related effects.

4.15.3.3 Alternative C

Under Alternative C, it is assumed that the operators would propose to drill an equivalent number of wells each year as under the Proposed Action. Consequently, Alternative C noise effects would be the same as the Proposed Action. To the extent that fewer wells were drilled as a result of Alternative C, there would be correspondingly fewer locations where noise disturbances would occur.

4.15.3.4 Alternative D

Under Alternative D, it is similarly assumed that the operators would propose to drill an equivalent number of wells each year as under the Proposed Action. Consequently, Alternative D noise effects would be the same as those associated with the Proposed Action. To the extent that the operators were unable to maintain the anticipated pace of development and remain within disturbance limits, the number of sites with noise disturbances would be reduced proportionately to reductions in drilling and field development. Under these circumstances, the period during both drilling- and production-related noise disturbances would likely be extended.

4.15.4 Additional Mitigation

In addition to the measures described in appendix E, measures to mitigate noise impacts would include the following:

> In any area of operations where noise levels may exceed federal OSHA safe limits, the operators and their contractors would provide and require the use of proper personnel protective equipment by employees.

4.16 Wild Horses

Because SMAs are areas within the ARPA, impacts to these areas have been evaluated by resource in this chapter. This section, therefore, is organized by SMAs instead of the six topics included under previous sections (e.g., impacts summary, additional mitigation measures.

4.17 Special Management Areas

4.17.1 Introduction

Currently, there are two existing special management areas that are partially within the ARPA. These areas are the Sand Hills ACEC and Red Rim Daley Cooperative Wildlife Habitat Management Area. The proposed JO Ranch expansion would become part of the Sand Hills ACEC through the addition of lands acquired from a land exchange. In addition, two special management areas have been proposed for the RFO draft RMP and include the Upper Muddy Creek Watershed/Grizzly area and the Cow Butte/Wild Cow area. Portions of the aforementioned proposed special management areas would also occur within the ARPA.

In general, special management areas that occur within the ARPA were delineated fro the protection of fish and wildlife species and their habitat. Therefore, the impact significance criteria would be the same as that found in the wildlife section (4.7.2, Impact Significance Criteria). In addition, impact significance criteria for the proposed Sand Hills/JO Ranch expansion area can be found in cultural section (4.11.2, Impact Significance Criteria).

BMPs will be applied under all alternatives as COAs where proposals conflict with identified resources (appendix H).

4.17.2 Direct and Indirect Impacts (Common to All)

4.17.2.1 Proposed Action

As described in detail in chapter 2, a total of 1,800 new CBNG wells and 200 conventional wells would be drilled and developed under this alternative during the next twenty years with an expected LOP of 30–50 years. Well placement within the ARPA is not known at this time, however, development would occur across the analysis area and within and near existing pods that were developed under the Interim Drilling Policy (appendix A).

On average, there would be 63 acres of pre– and 25 acres of post–reclamation disturbance with a maximum of eight well pads per section.

4.17.2.2 Alternative A (No Action)

Under the No Action Alternative, the Proposed Action would not be approved.

4.17.2.3 Alternative C

Under Alternative C, as under the Proposed Action, a total of 2,000 new CBNG wells would be drilled and developed under this alternative during the next twenty years with an expected life of project (LOP) of 30–50 years. However, development would potentially be constrained in areas that have critical resource concerns, such as fisheries, hydrology, soils and wildlife.

4.17.2.4 Alternative D

This alternative emphasizes reclamation and monitors successful reclamation within SMA's or Category A areas. These areas include management areas with sensitive fish populations, big game crucial winter range habitats, including ACECs, Wildlife Habitat Management areas, and

silver sage/antelope bitterbrush communities. Category A is about 72,200 acres in extent. A limitation is also placed on Category A areas to limit the disturbance to an average of less than 6.5 acres or less per well site location. Category A areas would be managed more intensively and emphasize successful reclamation. However, there is potential for all or a large portion of the disturbance for Category A areas to occur within a single SMA.

Annual planning would require the operators to submit to the BLM a proposed plan of operation for the forthcoming year. The BLM will then work with the operators at the site-specific level to minimize surface disturbance by applying appropriate lease stipulations, BMPs, COAs, and other measures deemed necessary to minimize impacts to this SMA.

4.17.3 Cow Butte/Wild Cow Area

The proposed Cow Butte/Wild Cow area consists of 63,697 acres and is managed to protect crucial winter range for big game and to maintain or enhance the aspen and mountain shrub complexes found within the area. A total of 40,414 acres (63 percent) of the proposed Cow Butte/Wild Cow area occurs with the ARPA.

4.17.3.1 Direct and Indirect Impacts

Direct and indirect impacts to the proposed Cow Butte/Wild Cow Creek area common to all alternatives would be similar to those found in impacts common to all alternatives in the wildlife section (4.7.3.1). Of special concern within this SMA are the steep slopes and gullies which have the potential to accelerate erosion that would lead to increased habitat degradation. Steep slopes would require additional surface disturbance to meet road standards, resulting in increased habitat loss. Impediments to wildlife movement from existing fences and habitat fragmentation would be compounded by increased surface disturbing activities associated with development.

The loss or reduction of usable elk crucial winter range is also a concern in the Cow Butte/Wild Cow Creek area. Impacts would result from restrictions of movement that would occur from high snow pack to the east at higher elevations and project development to the west at lower elevations. Therefore, there would be a reduction in available crucial winter range habitat for elk. This would further confine animals to the remaining crucial winter range habitat between the development areas and high snow pack areas. This would result in increased browse use of the remaining crucial winter range habitat and increase animal stress.

4.17.3.2 Proposed Action

Impacts to the Cow Butte/Wild Cow area from resource development would be similar to those described in section 4.7, Wildlife and section 4.8, Special Status Plants, Wildlife and Fish Species.

4.17.3.3 Alternative A (No Action)

Please refer to section 4.17.2.2.

4.17.3.4 Alternative C

Some of the development protection measures included in Alterative C would reduce road densities, minimize well pad size, and improve reclamation. This would occur through

site-specific review and mitigation to meet the requirements of the SMA. Existing levels of public access would be maintained through the use of remote monitoring and gating of new roads. The avoidance of important wildlife vegetation communities would be required, such as, aspen, juniper woodland, true mountain mahogany, and serviceberry communities. To avoid fragmentation of movement corridors, fences would be converted to BLM standards in coordination with grazing permitees. Detailed descriptions of resource concerns and protective measures can be found in appendix L.

4.17.3.5 Alternative D

Please refer to section 4.17.2.4.

4.17.4 Upper Muddy Creek Watershed/Grizzly Area

The Upper Muddy Creek Watershed/Grizzly area consists of 111,110 acres and is managed for protection of native Colorado fish fauna unique to the Muddy Creek watershed and big game crucial winter range (See section 4.7, wildlife and section 4.8, Special Status Plants, Wildlife, and Fish Species). A total of 20,966 acres (19 percent) of the Upper Muddy Creek Watershed/Grizzly area occurs within the ARPA of which 10,610 acres private, 9,748 acres BLM, and 638 acres State. However, sampling by BLM biologists and University of Wyoming researchers have identified the highest proportion of BLM sensitive native species within this portion of the ARPA (Bower 2005).

4.17.4.1 Direct and Indirect Impacts

Direct and indirect impacts to the proposed Upper Muddy Creek Watershed/Grizzly area common to all alternatives would be similar to those found in impacts common to all alternatives in the Wildlife section, 4.7.3.1, and Special Status Plants, Wildlife, and Fish Species section, 4.8.3.1.

4.17.4.2 Proposed Action

Impacts to the Upper Muddy Creek Watershed/Grizzly area from resource development would be similar to those described in section 4.7, Wildlife and section 4.8, Special Status Plants, Wildlife, and Fish Species.

4.17.4.3 Alternative A (No Action)

Please refer to section 4.17.2.2.

4.17.4.4 Alternative C

Some of the development protection measures included in Alternative C would reduce road densities, minimize well pad size, and improve reclamation through detailed development, transportation, and reclamation plans. In addition, no new road crossings of Muddy Creek would be allowed and existing levels of public access would be maintained through the use of remote monitoring and gating of new roads. Non-chlorine deicing and dust control agents would be used to minimize toxic effects to plants, fish, and other aquatic organisms. The avoidance of important wildlife vegetation communities would be required, such as, aspen, juniper woodland, true mountain mahogany, and serviceberry communities. To avoid fragmentation of movement corridors, fences would be converted to BLM standards in coordination with grazing permitees.

Detailed descriptions of resource concerns and protective measures for the Upper Muddy Creek Watershed/Grizzly area can be found in appendix L.

4.17.4.5 Alternative D

Please refer to section 4.17.2.4.

4.17.5 Sand Hills ACEC and Proposed JO Ranch Expansion

The Sand Hills ACEC consists of 12, 669 acres. This includes the JO Ranch Expansion which is currently proposed under the RFO draft RMP, and is managed for the protection of the unique vegetation community complex, to maintain wildlife habitat values, minimize soil erosion, and promote recreational opportunities. A total of 5,024 acres (39.7 percent) of the Sand Hills ACEC occurs within the ARPA.

4.17.5.1 Direct and Indirect Impacts

Direct and indirect impacts to the proposed Sand Hills ACEC and Proposed JO Ranch Expansion area common to all alternatives would be similar to those found in impacts common to all alternatives in the wildlife section, 4.7.3.1.

4.17.5.2 Proposed Action

Impacts to the Sand Hills ACEC and proposed JO Ranch expansion would be similar to those described in the direct and indirect impacts, common to all section, 4.17.2.1.

4.17.5.3 Alternative A (No Action)

Please refer to section 4.17.2.2.

4.17.5.4 Alternative C

Some of the development protection measures included in Alternative C would reduce road densities, minimize well pad size, and improve reclamation through detailed development, transportation, and reclamation plans. Existing levels of public access would be maintained through the use of remote monitoring, gating, and seasonal closures of new roads. Non-chlorine deicing and dust control agents would be used to minimize toxic effects to plants, fish, and other aquatic organisms. Surface disturbance within important wildlife vegetation communities such as silver sagebrush and antelope bitterbrush would be limited to protect important seasonal and crucial winter range habitats. To avoid fragmentation of movement corridors, fences would be converted to facilitate big game movement in coordination with grazing permitees. Detailed descriptions of resource concerns and protective measures for the Sand Hills SMA can be found in appendix L.

4.17.5.5 Alternative D

Please refer to section 4.17.2.4.

4.17.6 Red Rim/Daley Area

The Red Rim/Daley area consists of 25,962 acres and is managed for the protection of crucial winter range habitat for pronghorn antelope and nesting habitat for raptors. A total of 3,190 acres (19 percent) of the Red Rim/Daley area occurs within the ARPA.

4.17.6.1 Direct and Indirect Impacts

Direct and indirect impacts to the proposed Red Rim/Daley area common to all alternatives would be similar to those found in impacts common to all alternatives in the Wildlife section, 4.7.3.1.

4.17.6.2 Proposed Action

Impacts to the Red Rim/Daley area would be similar to those described in the Direct and Indirect Impacts (common to all, section 4.17.2.1).

4.17.6.3 Alternative A (No Action)

Please refer to section 4.17.2.2.

4.17.6.4 Alternative C

Some of the development protection measures included in Alternative C would reduce road densities, minimize well pad size, and improve reclamation. This would occur through site-specific review and mitigation to meet the requirements of the SMA. Existing levels of public access would be maintained through the use of remote monitoring and gating of new roads. To avoid fragmentation of movement corridors and crucial winter range, fences would be converted to BLM standards in coordination with grazing permitees. In addition to standard raptor wildlife stipulations, actions would be taken to minimize impacts to important nesting substrate. Detailed descriptions of resource concerns and protective measures can be found in appendix L.

4.17.6.5 Alternative D

Please refer to section 4.17.2.4.