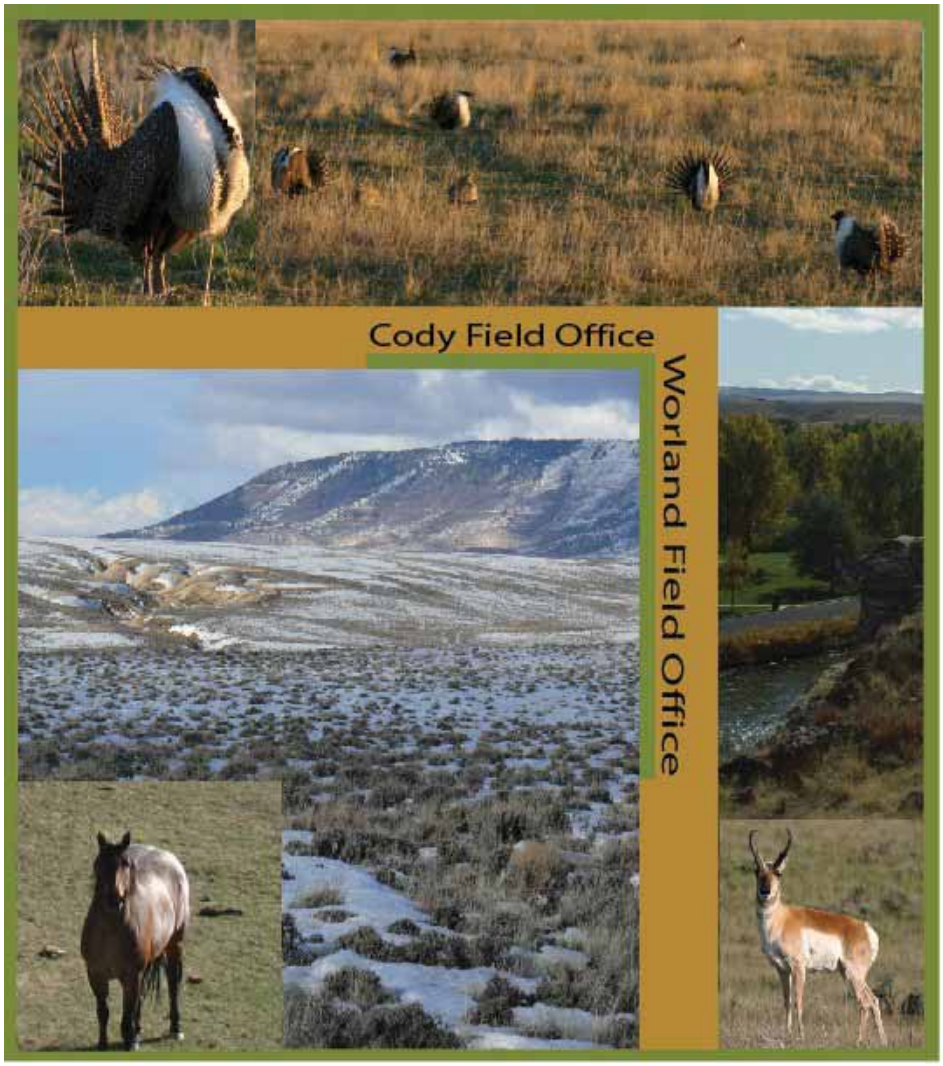
Bighorn Basin Resource Management Plan Revision Project

Draft Resource Management Plan and Draft Environmental Impact Statement



Volume 2 of 3
Chapters 4 - 6

April 2011

BLM

Wyoming - Cody & Worland Field Offices

The BLM's multiple-use mission is to sustain the health and productivity of public lands for the use and enjoyment of present and future generations.

The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

BLM/WY/PL-11/003+1610
Volume 2 of 3

Bighorn Basin Resource Management Plan Revision Project

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Chapters 4 - 6

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

and

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

April 2011

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CHAPTER 4 – ENVIRONMENTAL CONSEQUENCES

This chapter describes environmental consequences that may result from implementing the four alternatives described in Chapter 2. The purpose of this chapter is to determine the potential impacts of the federal action on the human environment. As defined by the Council on Environmental Quality (CEQ) the "human environment" shall be interpreted to include the natural and physical environment and the relationship of people with that environment (40 Code of Federal Regulations [CFR] 1508.14). The federal action is the Bureau of Land Management (BLM) selection of a resource management plan (RMP) on which to base future land use actions.

The analysis of environmental consequences focuses on key planning issues (see Chapter 1) raised during the scoping process rather than providing an encyclopedic discussion of all possible consequences. The organization of Chapter 4 follows the same order as Chapter 3 and allows the reader to compare existing resource conditions (Chapter 3) to potential impacts (Chapter 4) for the same resource. The following describes the organization of information for the analysis of each resource or resource use.

Introduction

The discussion of environmental consequences for each resource program begins with a brief definition of an impact for the resource. When applicable, definitions of the following types of impacts also are included:

Adverse or Beneficial Impacts. When applicable, this chapter differentiates beneficial and adverse impacts. For example, an alternative that increases the number of water sources away from existing rivers and streams is expected to have a beneficial impact on livestock grazing and riparian/wetland areas; however, if this alternative also increases livestock concentration around new water sources, it may adversely impact grassland and shrubland communities by degrading vegetation and compacting soil in these areas. The purpose of presenting both beneficial and adverse impacts for key planning issues is to help the BLM decision maker and readers understand the multiple-use tradeoffs associated with each alternative. However, this chapter does not describe all possible impacts and, unless otherwise stated, assume that impacts described in this chapter would be adverse.

Direct or Indirect Impacts. In general, direct impacts result from BLM-authorized activities and generally occur at the same time and place as the management activity or action causing the impact. For example, for the action of building a road, a direct adverse impact is surface disturbance. Surface disturbance is the impact (the effect) of heavy equipment (the cause) removing existing vegetation as it grades the proposed road location. Indirect impacts often occur at some distance or time from the action. In the example above, an indirect impact could occur days after the surface is disturbed and some distance from the disturbance. Heavy precipitation following vegetation removal and ground disturbance could erode soil and transport sediment into streams. Therefore, the impact to stream water quality would be an indirect adverse impact.

Short- or Long-term Impacts. Where applicable, this chapter describes the short-term or long-term aspects of impacts. For purposes of this RMP, short-term impacts occur during or after the activity or action and may continue for up to 5 years. For example, for the action of a prescribed fire, a short-term adverse impact is loss of vegetative cover. Long-term impacts occur beyond the first 5 years, an approximation of the time required to restore or reclaim an area following surface disturbance. Long-term beneficial impacts of prescribed fire include diversifying vegetation structure and restoring fire-adapted ecosystems to prevent larger, more damaging wildland fires.

Methods and Assumptions

This section describes the methods and assumptions used in the impact analysis for each resource or resource use. Due to the programmatic and strategic nature of the RMP alternatives, the timing and specific location of project-specific actions that could affect resource values are not defined. Moreover, the relationship between cause (future actions) and effect (impact on resources) is not always known or quantifiable. For these reasons, alternative analyses are both qualitative and quantitative, and based on a series of assumptions. The methods and assumptions listed for each section, and in the general assumptions presented below, provide a basis for the conclusions reached in this chapter.

Summary

The summary section for each resource program briefly discusses the overall impacts resulting from implementation of the alternatives and compares the alternatives in terms of their anticipated impact intensity (from greatest to least). The summary section compares impacts among the Action Alternatives (alternatives B, C, D) and the No Action Alternative (Alternative A). In some cases, there are no discernable differences in impacts among the alternatives.

Detailed Analysis of Alternatives

The detailed analysis of alternatives describes how each alternative could affect baseline conditions of individual resources in the Bighorn Basin planning area (Planning Area). The alternatives analyses typically describe impacts grouped into broad topic areas and in the following order: surface disturbance, resource uses, special designations, resources, and proactive management actions. Proactive management actions include management actions included to protect or enhance the resource of interest. For example, proactive management actions for soils include requiring topsoil salvage and segregation for all surface-disturbing activities. If an impact analysis does not discuss the effect of a particular allowable use or management action on a given resource, it is because the BLM does not expect impacts or expects impacts to be minimal, or the anticipated impact is outside the scope of this analysis, as described in Chapter 1 of this document.

Cumulative Impacts

Cumulative impacts combine the past and present impacts encompassed in existing conditions described in Chapter 3 with the anticipated incremental impacts of alternatives described in the sections of this chapter and the impacts of reasonable foreseeable actions. The *Cumulative Impacts* section, which appears at the end of this chapter, also includes anticipated incremental impacts of non-BLM reasonable foreseeable actions.

Assumptions Common to All Analyses

The list below identifies assumptions common to all alternatives and all resources. Individual resource sections list assumptions unique to specific resources and resource uses.

- Key planning issues identified in Chapter 1 provide the focus for the scope of impact analyses in this chapter.
- In general, the BLM considers adverse impacts described in this chapter important if they result from or relate to the key planning issues described in Chapter 1 and their context or intensity (see *Glossary*) indicate that they may result in impacts to public health and safety; a potential for violating legal standards, laws, or protective status of resources; or potential impacts to unique resources.

- The analysis of impacts focuses on the anticipated incremental and meaningful impact of management actions and allowable uses proposed for each alternative. The description of existing conditions in Chapter 3 encompasses the impacts of past and present actions.
- The purpose of the comparison of impacts among resources is to provide an impartial assessment to inform the decision maker and the public. The impact analysis does not imply or assign a value or numerical ranking to impacts. Actions resulting in adverse impacts to one resource may impart a beneficial impact to other resources.
- When adverse impacts to other resources would occur, "on a case-by-case basis" means an action would only be allowed when impacts can be adequately mitigated consistent with other resource goals and objectives.
- For impact analysis, short-term is generally defined as being less than 5 years and long-term as being greater than 5 years, unless otherwise noted for a specific resource; the life of the plan is assumed to be 15 to 20 years.
- Existing state and federal environmental legislation and regulatory programs would remain relatively unchanged and in effect (i.e., analyses are based on current, rather than projected, future regulations).
- To the extent possible and within legal and regulatory parameters, BLM management and planning decisions will be consistent with the planning and management decisions of other agencies, state and local governments, and Native American tribes with jurisdictions intermingled with the Planning Area.
- Funding would be available to implement the alternatives described in Chapter 2.
- The BLM would implement any of the alternatives in compliance with standard practices, best management practices (BMPs) (Appendix L), guidelines for surface-disturbing activities, and mitigation guidelines (Appendix H). The practices and guidelines included in Appendices H and L are a component of each alternative. Appendix H lists standard practices used in the Planning Area to mitigate adverse impacts caused by surface-disturbing activities *(Wyoming BLM Mitigation Guidelines for Surface-disturbing and Disruptive Activities).*
- The *Glossary* (in Volume 3) defines surface-disturbing activities employed in the analyses. The BLM typically describes surface disturbance in terms of the total acres of short- or long-term disturbance from BLM actions, as shown in Table 4-1. Appendix T lists projected surface disturbance associated with individual reasonable foreseeable actions, including surface disturbance for new wells that are subsequently abandoned and reclaimed. For analysis purposes, the acreage of surface disturbance for new well pads and associated facilities varies with the fields, areas, structures, and formations developed, and assumes there will be one well pad per producing well. See Appendix H for the Wyoming BLM Mitigation Guidelines for Surface-disturbing and Disruptive Activities.
- Concentrated livestock and native ungulate grazing, off-highway vehicle (OHV) use, and fire may remove vegetation and expose the soil surface leading to increased erosion.
- Ongoing natural and human-caused changes to vegetation communities would continue in the absence of management intervention.
- Vegetation treatments would be performed only in habitats that would benefit from such treatments.
- The successful application of treatments to specific areas/watersheds would result in the maintenance or reestablishment of the desired range of conditions for the major vegetation communities in approximately the desired proportions.

- Mitigation requirements would prevent or limit direct impacts associated with land use activities, including reclamation of land after completion of the activity.
- For purposes of analysis, it is assumed that lands identified for withdrawal under each alternative would be withdrawn. Where not otherwise noted, discussions of areas withdrawn under the various alternatives are assumed to include existing withdrawals, existing withdrawals where the withdrawals would be extended, and areas that would be recommended for withdrawal. While an RMP can make recommendations, closing areas to operation of the mining laws (i.e., withdrawing) occurs outside of the RMP revision process. Table 4-13 identifies existing and proposed withdrawals under the alternatives.
- An oil and gas lease grants the lessee the "right and privilege to drill for, mine, extract, remove and dispose of all oil and gas deposits" in the leased lands, subject to the terms and conditions incorporated in the lease (BLM Form 3100-11, Lease for Oil and Gas). Because the Secretary of the Interior has the authority and responsibility to protect the environment within federal oil and gas leases, the BLM imposes restrictions on the lease terms.
- The United States (U.S.) Court of Appeals for the D.C. Circuit in *Sierra Club v. Peterson*, 717 F.2d. 1409 (D.C. Cir. 1983) found that "on land leased without an NSO stipulation, the DOI (U.S. Department of the Interior) cannot deny the permit to drill…once the land is leased the DOI no longer has the authority to preclude surface-disturbing activities even if the environmental impact of such activity is significant. The Department can only impose mitigation upon a lessee who pursues surface-disturbing exploration and/or drilling activities." The court goes on to say "notwithstanding the assurance that a later site-specific environmental analysis will be made, in issuing these leases the DOI has made an irrevocable commitment to allow some surface-disturbing activities, including drilling and road building."
- Provisions in leases that expressly provide Secretarial authority to deny or restrict development in whole or in part depend on an opinion provided by the U.S. Fish and Wildlife Service (USFWS) regarding impacts to endangered or threatened species or habitats of plants and animals listed or proposed for listing. If the USFWS concludes that the development likely would jeopardize the continued existence of any endangered or threatened plant or animal species, then the development may be denied in whole or in part.
- The BLM cannot predict the exact locations of future surface-disturbing activities at the RMP level. Unless a management action for a vegetation type specifies otherwise, surface-disturbing activities are assumed to occur in vegetation types in proportion to their availability within the Planning Area. Impact acreage for vegetation types are not absolute, but serve as a relative comparison among alternatives.

Table 4-1. Total Projected Surface Disturbance from BLM Reasonable Foreseeable Actions in the Bighorn Basin Planning Area

Action	Alternative A	Alternative B	Alternative C	Alternative D (Agency Preferred)
Total Acres Short-Term Disturbance from BLM Actions	136,415	73,919	245,783	140,508
Total Acres Reclaimed from BLM Actions	120,704	63,037	204,238	122,065
Total Acres Long-Term Disturbance from BLM Actions	15,710	10,882	41,545	18,443

Source: Appendix T
BLM Bureau of Land Management

4.1 Physical Resources

4.1.1 Air Quality

The actions associated with each alternative may affect future air quality within the region ("region" includes the Planning Area [Map 1] and federal Class I areas within 100 miles). Adverse impacts to air quality are those that increase emissions (air pollutants, hazardous air pollutants [HAPs], and sulfur and nitrogen compounds) that affect visibility, air pollutant concentrations, and atmospheric deposition. Beneficial impacts are those that decrease emissions, from either control measures or a reduction in activities that generate emissions. Direct impacts result from management that may increase or reduce emissions from a source or resource use. Indirect impacts result from management that affects subsequent activities that may increase or reduce emissions. This section describes the expected qualitative impacts of each alternative on air quality in terms of short-term and long-term impacts.

4.1.1.1 Methods and Assumptions

Emissions were estimated for the proposed management actions in each alternative for particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOCs), and HAPs. The BLM estimated emissions for the base year (2005) corresponding to Alternative A. This year was selected for the base year because it was the closest year with the most complete information. The BLM also estimated emissions for two future years (2015 and 2024) to examine potential impacts mid-way through the 20-year plan and at the end of the plan. The analysis compares operational emissions for 2015 and 2024 to base-year emissions to determine the expected future change in emission levels for each alternative. Given the uncertainties concerning the number, nature, duration, and specific location of future emission sources and activities, the emission comparison approach provides an appropriate basis for comparing the potential impacts under each alternative.

Activity data used to estimate emissions for proposed emission sources were obtained from the BLM Resource Specialists in the Cody and Worland field offices (CYFO and WFO). Emission factors used to estimate proposed emissions were obtained from (1) the U.S. Environmental Protection Agency (EPA) NONROAD2008a Emissions Model (EPA 2008), (2) Wyoming Department of Environmental Quality (DEQ) best available control technology (BACT) levels for natural-gas-fired internal combustion engines, and (3) the EPA MOBILE6.2.03 mobile emissions factor model for on-road motor vehicles (EPA 2003). The Technical Support Document for Air Quality (Appendix U) includes information regarding the data and assumptions used to estimate emissions for each project alternative and the detailed emission totals for each activity per year.

Methods and assumptions used in this impact analysis include the following:

- Stationary sources associated with oil and gas development would operate at emission levels based on currently observed BACT levels.
- Activity data associated with management actions other than those related to conventional natural gas and oil wells were averaged over the entire analysis period to produce annual average emissions. Oil and gas activity follows reasonable foreseeable development (RFD) projections in both time and duration. Estimation of activity for each resource is sufficient for base year and future year emission projections.

- EPA off-road emission standards were used to estimate emissions for nonroad sources in project years 2005/2015/2024. This approach simulates the replacement of existing sources by new lower-emitting equipment with future EPA off-road emission standards.
- The analysis in this section estimated only emissions from permitted activities that would occur on federal lands within the Planning Area.
- Recognizing site-specific and season-specific variations, the use of water application as a BMP would reduce fugitive dust emissions from ground-disturbing activities during construction/reclamation and maintenance of roads by 50 percent from uncontrolled levels.

Analysts calculated emissions for the following types of development and use activities: (1) oil development, (2) natural gas development, (3) salable minerals development, (4) locatable minerals development, (5) renewable energy development, (6) livestock management activities, (7) vegetation management, (8) vegetation management of invasive species, (9) fire management (including prescribed fire), (10) forests, woodlands, and forest products activities, (11) rights-of-way (ROW) and corridors, (12) OHV use, and (13) resource road maintenance. Emission estimates are provided for all of the alternatives. Fugitive VOC emissions from oil and gas development operations and emissions from any prescribed fire activities conducted on BLM land within the Planning Area have not been estimated in this analysis. In addition, activities related to the management of cultural resources, paleontology, recreation, and fish and wildlife would produce inconsequential amounts of emissions to the atmosphere.

It should be noted that impacts for all alternatives have been analyzed herein using estimates of emissions only, rather than any type of air quality modeling. If a particular project is proposed under any of the alternatives, the BLM may require that a quantitative air quality modeling analysis be conducted to determine the potential effects from proposed emission sources and the effects of potential mitigation strategies for projects expected to approach or exceed the applicable standards. For quantifying the potential impacts of project emissions on ozone and secondary $PM_{2.5}$, an air quality modeling system such as the EPA's Community Multiscale Air Quality (CMAQ) model or the similar, alternative Comprehensive Air Quality Model with extensions (CAMx) model, would be used. The modeling exercise would require substantial resources and time to (1) gather regional precursor emissions from all anthropogenic and biogenic sources, (2) simulate the meteorological conditions for a sufficient period of time (typically a 1-year period) with a meteorological model, and (3) use this information to apply the air quality model and assess future-year impacts using the future-year emission estimates. Because ozone and $PM_{2.5}$ are secondary pollutants and the atmospheric chemistry of their formation is not always linear, the application of an air quality modeling system such as CMAQ (or CAMx) is the best way to assess potential future air quality impacts for these pollutants. With models such as CMAQ or CAMx, impacts from individual sources or groups of sources can be separately assessed to quantify impacts and evaluate potential control or mitigation measures to reduce emissions.

4.1.1.2 Summary of Impacts by Alternatives

Air quality impacts would primarily result from minerals development and production, and oil and gas activities; emissions associated with these actions would outweigh those produced from other proposed activities. Alternative B would result in the lowest levels of emissions in 2015 and 2024 by reducing all emissions—except for CO, which would increase slightly—and, therefore, it is unlikely that emissions under this alternative would contribute to an exceedance of a National Ambient Air Quality Standard (NAAQS) or Wyoming Ambient Air Quality Standard (WAAQS). Alternatives A and C would result in increases for some pollutants (PM_{10}, CO) and decreases for all others compared to the 2005 base year. Alternative C would have the greatest potential to contribute to exceedances of the NAAQS or WAAQS

of any alternative. Alternative D would result in comparable impacts to the base level (year 2005), except that VOC emissions are expected to decrease by 13 percent in 2015 and by 34 percent by 2024; projected emissions are, therefore, unlikely to contribute to an exceedance of a NAAQS or WAAQS. Refer to Table 4-2 for a summary of emissions by alternative. Alternative C is projected to result in the most new oil and gas wells and locatable mineral development (the activities anticipated to result in the greatest CO_2 contributions during the planning cycle), resulting in the most CO_2 emissions, followed by alternatives D, A, and B respectively.

4.1.1.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Components of air quality that may be impacted include visibility, air pollutant concentrations, and atmospheric deposition. Air quality impacts would primarily result from minerals development and production, and oil and gas production as potential emissions associated with these actions would substantially outweigh those produced from any other proposed activity.

Table 4-2. Total Annual Emissions Summary for BLM Activities within the Bighorn Basin Planning Area

Summary Year	Emissions (tons per year)						
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	HAP
Base Year (2005) Total	2,507	342	1,101	108	2,719	2,143	117
Alternative A							
2015 Total	2,641	354	1,073	106	2,905	1,925	111
2024 Total	2,679	354	1,134	108	2,731	1,473	95
Alternative B							
2015 Total	2,376	310	748	67	2,808	1,780	96
2024 Total	2,401	308	794	68	2,612	1,382	85
Alternative C							
2015 Total	3,134	422	1,157	115	2,949	2,064	126
2024 Total	3,174	422	1,221	117	2,779	1,563	105
Alternative D							
2015 Total	2,514	340	1,045	102	2,907	1,865	105
2024 Total	2,551	340	1,109	103	2,737	1,415	89

Source: BLM 2010c

BLM	Bureau of Land Management	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
CO	carbon monoxide	PM_{10}	particulate matter less than 10 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Air Quality

Mineral development and production would result in short-term air quality impacts from five sources: (1) combustive emissions (vehicle tailpipe and exhaust stack emissions) due to the operation of mobile and stationary source construction equipment; (2) fugitive dust emissions (PM_{10}) due to earthmoving activities and the operation of vehicles on unpaved surfaces; (3) NO_X and particulate emissions from

blasting and oil and gas well construction activities and drilling rig equipment; (4) PM emissions from fire management; and (5) VOC and CO emissions associated with OHV use (all terrain vehicles, off-road motorcycles [dirt bikes], and snowmobiles), vehicular traffic and oil and gas well construction and production equipment. The primary $PM_{2.5}$, NO_x, and SO_2 emissions may result in the formation of secondary $PM_{2.5}$ and would affect total measured $PM_{2.5}$ concentrations. Increases in $PM_{2.5}$ would also affect visibility in the region. The VOC, NO_x, and CO emissions may affect the formation of ground-level ozone, a criteria pollutant. Ozone is a secondary pollutant not directly emitted, but rather formed in the lower atmosphere by a series of reactions involving ultra violet (UV) radiation and precursor emissions of NO_x, VOC, and CO. NO_x consists of nitric oxide (NO) and nitrogen dioxide (NO_2), which are primarily emitted from anthropogenic sources. VOCs consist of thousands of individual hydrocarbon and oxygenated hydrocarbons emitted from both man-made and biogenic sources (trees). Ozone formation in the troposphere is affected by local weather conditions (winds, temperature, solar radiation, and horizontal and vertical dispersion characteristics), which influence precursor concentrations, reaction rates, formation, transport, and deposition.

In recent years in Sublette County, Wyoming (BLM Pinedale planning area), 8-hour average ozone concentrations that exceed the NAAQS have been measured during the winter months. This is a result of a unique set of topographic and atmospheric conditions that include high pressure, light winds, a strong radiation inversion, and adequate snow cover. The atmospheric conditions limit precursor dispersion while the snow cover increases albedo, resulting in much higher UV radiation and NO_2 photolysis rates. In 2009, the Governor of Wyoming recommended the Sublette County area (and parts of two adjacent counties) be classified as an ozone nonattainment area. Because of the lack of monitoring, it is impossible to know whether the Bighorn Basin area also experiences wintertime ozone episodes such as those occurring in the Pinedale planning area. Air quality data from monitors located in nearby areas showed no exceedances of the 8-hour ozone standard in 2009. The lack of ozone monitors in the Bighorn Basin makes it difficult to speculate about the potential impacts of emissions from the various alternatives, including Alternative D, to future ozone air quality in 2015 and 2024.

Minerals production would generate long-term combustive and fugitive dust emissions from two sources: (1) stationary sources, such as natural gas flaring, natural gas-fired compressors, and minerals storage and handling equipment; and (2) mobile sources that access and service oil and gas facilities and extract and handle subsurface minerals, such as hard minerals. Minerals reclamation activities also would produce combustive emissions and fugitive dust.

Management actions and resource uses under each of the alternatives may impact air quality related values (AQRVs) within the federal Class I areas of Yellowstone National Park, and the North Absaroka, Washakie, Bridger, and Fitzpatrick NWAs. Although minerals development and production and oil and gas production would be the primary sources of emissions, other resource management actions that would produce combustive and/or fugitive dust emissions include the following: forestry production, fire and fuels management, road maintenance, ROWs, and OHV use (especially for CO and VOC emissions). This analysis assumes that the expected activity and resulting emissions for these other resource management actions would be the same for all alternatives for 2015 and 2024.

The Wyoming DEQ has the authority to implement emission controls for sources requiring air permits under Wyoming Air Quality Standards and Regulations and to ensure that these sources do not contribute to an exceedance of an ambient air quality standard. To facilitate this process, the BLM currently implements a program to share emission source information with the Wyoming DEQ and other government agencies. This program would continue under all alternatives. In addition, the BLM would require implementation of BMPs within its authority to minimize impacts, such as fugitive dust emissions in proximity to high use roadways, populated areas, and resource-sensitive areas. Prior to

site-specific project approval, the BLM would conduct environmental analyses in compliance with the National Environmental Policy Act (NEPA).

Under all alternatives, site-specific hydrogen sulfide (H_2S) plans would be prepared for all oil and gas wells in compliance with the requirements of Occupational Safety and Health Administration and Onshore Order #6. These H_2S plans may include requirements to monitor wind speed, wind direction, and atmospheric stability, and to conduct dispersion modeling analyses for H_2S. These requirements would apply to areas where public health and safety or important resource values are a concern, such as proposed well sites in proximity to residences. If the BLM determines after review of an H_2S plan that additional data or safety precautions are needed, the BLM may require these items as conditions of approval (COA). Section 4.8.3 *Health and Safety* discusses management and impacts of H_2S.

Greenhouse Gases

Under all of the alternatives, a variety of activities in the Planning Area would generate greenhouse gas (GHG) emissions, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These activities include oil and gas and other minerals development, fire events, motorized vehicle use, livestock grazing, facilities development, and other surface-disturbing activities. The lack of scientific tools designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts. Currently the BLM does not have an established mechanism to accurately predict the effect of resource management-level decision from this planning effort on global climate change. Since the Industrial Revolution, atmospheric concentrations of CO_2 have risen about 36 percent (IPCC 2007a), principally due to the combustion of fossil fuels. Fossil fuel combustion accounted for 94 percent of national CO_2 emissions in 2008 (EPA 2010). Activities that require fossil fuel-powered machinery, such as minerals development and motorized vehicle use, would comprise the majority of CO_2 emissions in the Planning Area under all of the alternatives. Wildland fires, including prescribed burns, would also result in CO_2 emissions. However, CO_2 from fires, particularly prescribed fires, is typically considered to be counterbalanced by the increased productivity of existing larger vegetation and new growth of vegetation post fire. Alternative C is projected to result in the most new oil and gas wells and locatable mineral development (the activities anticipated to result in the greatest CO_2 contributions during the planning cycle), resulting in the most CO_2 emissions, followed by alternatives D, A, and B respectively (see Tables 4-3 and 4-4 for CO_2 emissions by alternative measured in CO_2 equivalents).

CH_4 is more than 20 times as effective as CO_2 at trapping heat in the atmosphere and accounted for 8.2 percent of GHG emissions in 2008 (based on CO_2 equivalents) (EPA 2010). CO_2 equivalent is a measurement that allows an aggregate comparison of multiple GHGs (e.g., CH_4 and N_2O), created by multiplying the actual or anticipated emissions of each gas by its relative global warming potential. Oil, gas, and locatable mineral development and enteric fermentation from livestock (which accounted for 25 percent of total CH_4 emissions in 2008 [EPA 2010]) are the predominant source of CH_4 emissions in the Planning Area. As a result of higher levels of mineral development, CH_4 emissions are anticipated to be highest under Alternative C, followed by alternatives A, D, and B respectively. Animal Unit Month (AUM) projections under alternatives A, C, and D are similar, and therefore would result in similar CH_4 emissions. Alternative B would reduce AUMs by about 50 percent, resulting in a proportional reduction in CH_4 emissions from enteric fermentation.

N_2O emissions, which like CH_4 are also more effective heat trapping agents than CO_2, in the Planning Area would result predominantly from fuel combustion in motor vehicles that are likely to be greatest under Alternative C, followed by alternatives A, D, and B.

Under all alternatives, management actions would likely affect the level of carbon sequestration in the Planning Area. Management that conserves carbon sinks or provides for research and technology to

store carbon that would otherwise be released into the atmosphere would reduce overall contributions of GHGs. Alternative B would result in the greatest preservation of biological carbon sinks including vegetation and soils, followed by alternatives D, A, and C. Forest management practices and silvicultural treatments that improve forest health and reduce the risk of catastrophic wildlife may increase or maintain carbon sequestration in forests and woodlands in the short term; however, altering the natural fire regime through forest management may lead to long-term impacts on forest health (e.g., infestation) that affect carbon sequestration in forests and woodlands. Alternative C includes the greatest number of silvicultural practices and other treatments to actively manage forests and woodlands, followed by alternatives D, A, and B. Allowing carbon sequestration research and projects under Alternative C and considering carbon sequestration research and projects under Alternative D would increase the potential for carbon sequestration projects and management that reduces atmospheric CO_2, compared to the alternatives.

Table 4-3. Carbon Dioxide Equivalent Emissions in Metric Tons by Alternative in 2018

	Oil Emissions[1]	Natural Gas Emission[1]	Locatable Emissions[1]	Total
Alternative A	34,014	250,944.63	5,816	290,776
Alternative B	20,735	238,378.63	5,761	264,876
Alternative C	37,078	261,474.07	5,817	304,369
Alternative D	32,482	261,297.89	5,351	299,132

Source: BLM 2010c
[1]Carbon Dioxide Equivalent is a measurement that allows an aggregate comparison of multiple greenhouse gases, created by multiplying the emissions of each gas by its relative global warming potential. For this analysis however, metric tons of Carbon Dioxide Equivalent includes only carbon dioxide (CO_2) emissions.

Table 4-4. Carbon Dioxide Equivalent Emissions in Metric Tons by Alternative in 2028

	Oil Emissions[1]	Natural Gas Emission[1]	Locatable Emissions[1]	Total
Alternative A	34,656	303,327.49	5,817	343,799
Alternative B	21,279	269,796.61	5,762	296,837
Alternative C	37,743	319065.872	5,817	362,626
Alternative D	33,113	318,936.66	5,352	357,401

Source: BLM 2010c
[1]Carbon Dioxide Equivalent is a measurement that allows an aggregate comparison of multiple greenhouse gases, created by multiplying the emissions of each gas by its relative global warming potential. For this analysis however, metric tons of Carbon Dioxide Equivalent includes only carbon dioxide (CO_2) emissions.

Alternative A

Figure 4-1 presents a summary of annual emissions for the base year (2005) and for 2015 for each alternative. Figure 4-2 presents a summary of annual emissions for the base year and for 2024 for each alternative. Appendix U provides the details regarding the emission calculations and emission summary tables.

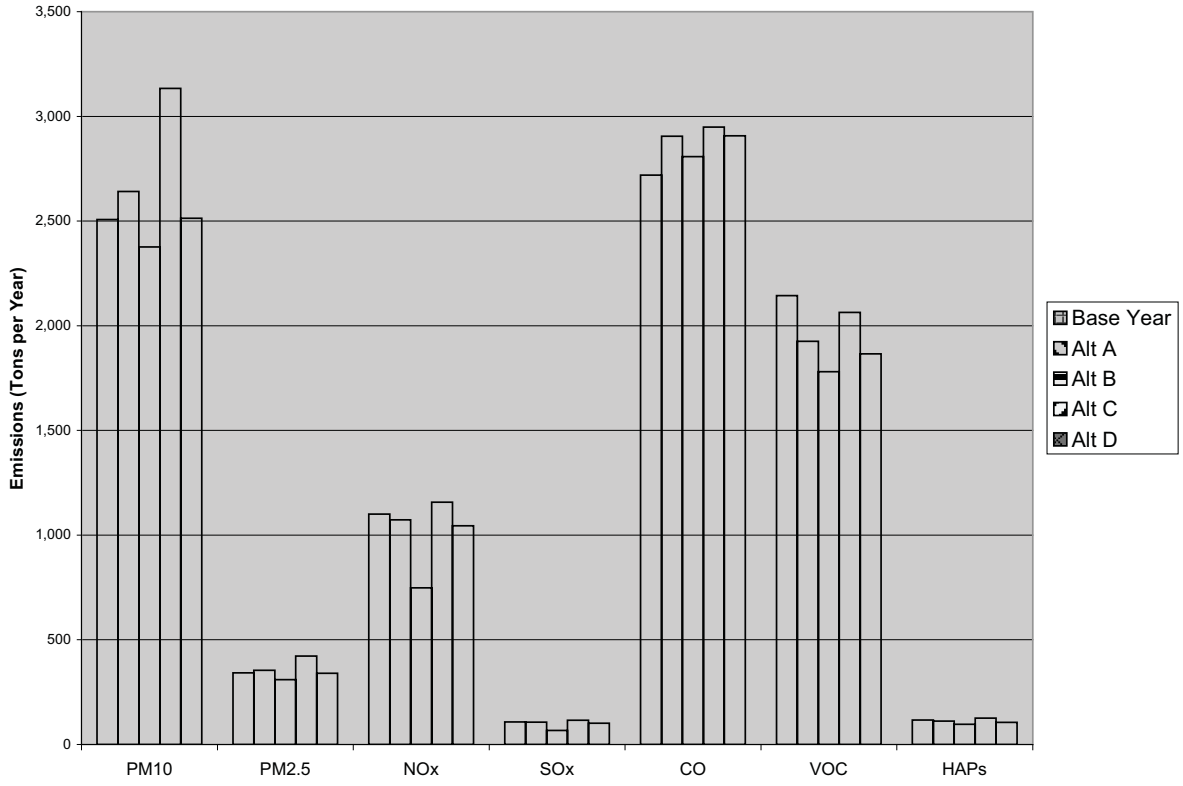
For Alternative A (current management), Figure 4-1 indicates that emission estimates for 2015 are greater than those for 2005 for PM_{10}, $PM_{2.5}$, and CO, and slightly lower for NO_X, SO_X, VOC and HAPs. By

2024, emissions for all pollutants (except VOCs and HAPs) would be greater than in 2005, with the largest increase in PM_{10} emissions, which are expected to increase by 173 tons per year (7 percent).

The Planning Area is a large, irregularly shaped region with an east-west extent of approximately 100 miles, a north-south extent of 105 miles, and a northwest-southeast extent of 150 miles. Given the generally good air quality in the region currently and the expected separation of sources within the Planning Area, it is unlikely emissions from Alternative A would contribute to an exceedance of NAAQS or WAAQS. There may be localized air quality impacts (potentially on local ozone) depending on the locations and emission levels of proposed sources in the area, the surrounding topographical characteristics, and the site-specific meteorology.

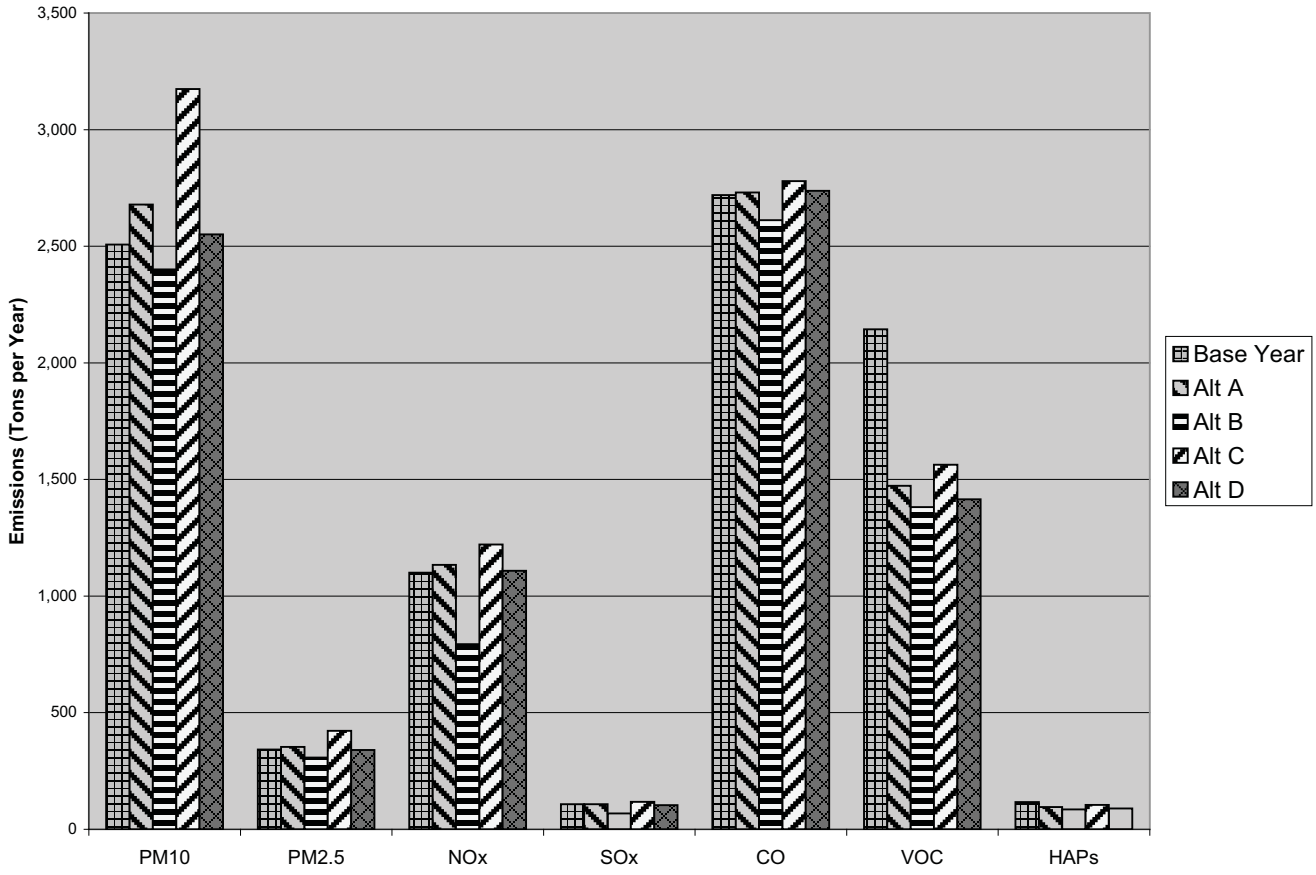
The impacts of these estimated future air emissions at the nearby federal Class I areas under Alternative A are difficult to quantify with any level of confidence without information on the specific locations and characteristics of projected sources in the Planning Area. As noted above, air quality modeling can be used to estimate these impacts, and this requires detailed information regarding source location/characteristics, topography/land use, and local and regional meteorology to accurately quantify the potential spatial and temporal aspects of air quality impacts from the various emission sources/activities. In addition, the Wyoming DEQ air-permitting processes would require larger development projects to identify the locations for specific emission sources to demonstrate with air quality modeling analyses that proposed emissions would not adversely affect ambient air quality and AQRVs in federal Class I areas.

Figure 4-1. Emissions Estimates for 2015 from BLM Activities in the Bighorn Basin Planning Area



Source: BLM 2010c

Figure 4-2. Emissions Estimates for 2024 from BLM Activities in the Bighorn Basin Planning Area



Source: BLM 2010c

In addition to the proposed sources of HAPs within the Planning Area, there also may be emissions of H_2S in the area. These sources would include fossil fuel combustion, fugitive VOCs, and emissions due to oil and gas production. The accidental release of "sour" natural gas (rich in H_2S) poses the main risk under Alternative A. Another source of release of H_2S is at oil and gas fields where secondary recovery operations are occurring.

Under Alternative A, qualitative air quality analyses are performed for activities with expected effects to air resources and quantitative air quality modeling may be performed on a case-by-case basis. If an analysis shows that significant impacts are possible, mitigation measures within BLM authority would be implemented or applied to reduce potential adverse impacts to air quality. However, the Wyoming DEQ Air Quality Division has the authority to require demonstration of compliance with federal and state air quality regulations and standards for any substantial future development action under their jurisdiction, which may include quantitative analysis.

Alternative B

As shown in Figure 4-1 and Figure 4-2, Alternative B would result in the lowest emissions of any of the alternatives, for both 2015 and 2024. Compared to the base year 2005 estimates, Alternative B would result in lower emissions for all pollutants for both future years, except for CO in 2015 where a slight

increase is expected. VOC emissions would drop by 759 tons or 35 percent in 2024 due to development constraints in Alternative B. This would result in the lowest natural gas production—one of the principal sources of VOC emissions—of all alternatives and the expected reductions in emissions from cleaner OHV engines, the other principal source of VOC emissions.

As a result, this alternative would likely result in similar or smaller impacts to AQRVs at the nearest federal Class I areas similar to base year conditions. In addition, given the generally good existing air quality in the region, the BLM would not expect emissions under Alternative B to contribute to an exceedance of NAAQS or WAAQS. Implementing the mitigation measures common to all alternatives also would reduce emissions and air quality impacts associated with Alternative B.

Alternative C

Emission estimates for Alternative C, reflecting more resource use in the Planning Area, show slight to moderate increases in emissions by 2024 compared to the base year (2005). The largest increase is for PM_{10} emissions, with an expected increase of 668 tons (27 percent). The estimates for Alternative C are also consistently higher than those for Alternative A.

Because of the potential increases in emissions compared to Alternative A, it is possible that impacts under this alternative could contribute to exceedances of the NAAQS or WAAQS. Although the existing air quality in the region is considered good, limited measurements make it difficult to fully and comprehensively assess current conditions. Because of expected increases in emissions under this alternative, adverse impacts to AQRVs in the nearby Yellowstone National Park and other NWAs may occur. Implementing the mitigation measures common to all alternatives would reduce emissions and any air quality impacts associated with Alternative C.

Alternative D

As listed in Table 4-2 and depicted in Figures 4-1 and 4-2, the emission estimates for Alternative D are generally similar to or lower than Alternative A, except for a negligible increase in CO emissions. Similar to the other alternatives, it is quite difficult to speculate whether emissions for this alternative would contribute to an exceedance of NAAQS or WAAQS or would adversely affect AQRVs in nearby Class I areas. This alternative may require the application of an air quality model to determine project-specific and cumulative air quality impacts on ozone, $PM_{2.5}$, and visibility.

4.1.2 Geologic Resources

Management of geologic resources primarily addresses preserving unique geologic features such as paleontological resources, fragile easily eroded geological features, or scientifically important strata. Mineral development, as well as other surface-disturbing activities, can alter existing geologic features by disturbing, or excavating soil and rock. Sections 4.5 *Heritage and Visual Resources* and 4.7 *Special Designations* in this chapter discuss associated impacts to geologic resources. Section 4.2 *Mineral Resources* discusses impacts to mineral resources.

4.1.3 Soil

Soil resources provide the foundation for a variety of other resources and resource uses in the Planning Area. Adverse impacts to soils result from management actions that compact soil, increase erosion and runoff, disrupt soil stability, or reduce soil productivity. Surface-disturbing activities, such as mineral resources development, can result in removal of vegetative cover, soil compaction, reduced water infiltration, changes in physical and biological properties, and reduction in organic matter content.

Beneficial impacts to soils result from management that minimizes soil compaction or erosion and runoff, stabilizes soil, and increases soil productivity. For example, management allowing post-disturbance reseeding would stabilize the soil and limit erosion.

Direct impacts to soils result from activities that disturb the existing soils horizon through earth-moving activities or remove the vegetative cover—loosening the surface soil, compacting soil layers, and exposing soil particles to wind and water. Indirect impacts include management actions that increase the likelihood of soil erosion. Actions that create impervious surfaces (e.g., road construction) or new water sources (e.g., surface discharge of produced water) may increase runoff and erode soils.

Short-term impacts to soils are those that result from initial surface disturbance prior to completion of reclamation and revegetation activities. Long-term impacts are those that result from actions that leave bare ground and areas not reclaimed after 5 years. Long-term impacts to soil productivity would also result from disturbance that degrades the physical and biological properties of the soil.

4.1.3.1 Methods and Assumptions

The soils analysis uses the Water Erosion Prediction Project (WEPP) soil erosion model to analyze impacts to soil resources. WEPP simulates the conditions that affect erosion, such as the amount of vegetation canopy and soil water content, to estimate erosion rates. To facilitate this analysis, the Internet-based U.S. Forest Service (USFS) WEPP interfaces were used for erosion predictions using the "Disturbed WEPP" and "WEPP Road" modules.

Erosion rates are inherently difficult to predict. The rates of erosion predicted by WEPP are within +/-50 percent. Despite this lack of precision, these rates are appropriate for comparing and analyzing impacts of the alternatives on the soil resource. Erosion rates are calculated for different resource programs using surface-disturbance acreage figures as projected in the reasonable foreseeable action table in Appendix T.

WEPP model climate parameters were developed using Worland, Wyoming precipitation data at 5,000 feet above mean sea level to represent the entire Planning Area. Both the Disturbed WEPP and WEPP Road modules are limited to four soil textures (clay loam, silt loam, sandy loam, and loam). The WEPP analysis used a loam soil texture for all erosion predictions.

Disturbed WEPP has eight vegetative treatment options available: 20-year-old forest, 5-year-old forest, shrub-dominated rangeland, tall-grass prairie, short-grass prairie, low-severity fire, high-severity fire, and skid trail. By adjusting cover parameters, these vegetative treatment options can be applied to a wide variety of vegetative communities and land uses.

All WEPP erosion analyses used a 50-year simulation to represent the return interval.

The WEPP analysis used the following parameters:

- Slopes used in Disturbed WEPP – Upper slope 0 to 25 percent; lower slope 5 to 25 percent
- Slope lengths used in Disturbed WEPP – 300 feet (standard length used for environmental analysis in the Planning Area)
- Gradients used in WEPP Road – Road gradient 4 percent; fill gradient 30 percent; buffer gradient 15 percent
- Lengths used in WEPP Road – Road length 200 feet; fill length 15 feet; buffer length 130 feet
- Width used in WEPP Road – Road width 12 feet
- Rock cover used in Disturbed WEPP and WEPP Road – 5 percent

Appendix V provides a full list of the assumptions and parameters used in the WEPP analysis, and a table of erosion rates calculated by resource area.

Other assumptions used in this impact analysis include:

- The WEPP model predicts little or no erosion on undisturbed rangelands and forestlands.
- Bare soil (without vegetation or other surface cover) with a surface layer that has been altered from its natural condition is more susceptible to accelerated wind and water erosion than undisturbed soil.
- Implementing the *Wyoming Standards for Healthy Rangelands* (Appendix N) improves vegetation health, vigor, cover, and litter, as well as minimizes erosion rates in most areas.
- Wind erosion can affect soil productivity in a similar manner as water erosion. Because current soils data is not adequate to make a realistic determination of acres susceptible to wind erosion on rangelands, and there is no wind-erosion prediction technology available for use in a rangeland setting, this analysis will be limited to impacts resulting from water erosion.
- Most soils with a moderate water erosion potential within the Planning Area correlate with steep slopes (greater than 15 percent).
- For the purposes of this analysis, it is assumed that erosion rates following surface-disturbing activities return to background levels within 3 to 5 years following full reclamation (WEPP 2008).
- The BLM will use BMPs to reduce runoff, soil erosion, and sediment yield, and to retain water on the landscape.
- To be effective on highly erodible soils, more extensive BMPs than those in common use are required to be utilized and aggressively maintained. The risk of BMP failure is greater on highly erodible soils.
- Although some forms of surface disturbance are restricted on slopes greater than 25 percent, it is assumed disturbance on highly erosive soils is distributed across the landscape in the same proportion these soils occur on the land, unless a proposed management action specifies additional protective measures. In other words, if 5 percent of the soils in the Planning Area are highly erosive, then it is assumed that 5 percent of the projected total disturbance would occur on highly erosive soils.
- Projected surface disturbance for each alternative potentially modifies soils by disrupting soil stability, changing vegetative cover that can reduce nutrient recycling, damaging biological crusts, decreasing productivity, and increasing compaction. When these modifications occur on highly erodible soils, the potential for accelerated erosion is greater than on less erodible soils. Site-specific erosion predictions and calculations require detailed soil mapping of areas to be disturbed. Soil mapping during site-specific analysis enables the BLM to minimize disturbance of highly erodible or otherwise sensitive soils.
- Sensitive soils incur greater adverse impacts from surface-disturbing activities than nonsensitive soils. Sensitive soils are fragile and especially susceptible to adverse impacts from surface disturbance because they are highly erodible and saline, sodic, or alkaline, or have a low reclamation potential. These fragile soils have limited reclamation potential either because of the vegetative community, physical or chemical limitations, susceptibility to erosion, or steep slopes.
- Installing and maintaining erosion controls and other mitigation measures, such as BMPs, result in a substantial reduction in soil erosion, depending on site conditions. However, these measures may not reduce adverse soil compaction and productivity impacts.

- Subject to applicable laws and regulations, surface-disturbing activities on fragile soils, soils with low reclamation potential, and soils with highly erosive characteristics will be authorized on a case-by-case basis.
- Fine-textured soils are more susceptible to water erosion and compaction when wet, whereas coarse-textured soils are more susceptible to wind erosion.
- Unless constrained by a management action or other data, surface disturbance will increase throughout the Planning Area during the planning cycle.

4.1.3.2 Summary of Impacts by Alternative

Impacts to soil resources may result from surface disturbance associated with a variety of resource programs that result in vegetation removal including mineral resources development, motorized vehicle use, road construction, and recreation. Concentrated or improperly managed livestock grazing use can also result in adverse impacts to soil due to herbaceous vegetation removal. The greatest impacts to soil resources are anticipated under Alternative C, which would result in the greatest surface disturbance and erosion. The erosion rate due to surface-disturbing activities under Alternative C is estimated to be 66,555 tons per year in the long term, followed by Alternative D (29,546 tons per year), Alternative A (25,167 tons per year), and Alternative B (17,432 tons per year). Alternative B would result in the fewest potential adverse impacts to soil resources, because it includes the most restrictions on surface-disturbing activities compared to the other alternatives. Alternative B also includes the most proactive management to minimize adverse impacts to soils in disturbed areas, followed by alternatives D, C, and A.

4.1.3.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Soils on BLM-administered surface lands and federal mineral estate could be disturbed under each alternative by activities proposed across a variety of resource programs. In disturbed areas, the WEPP model predicts an erosion rate of 4.165 tons per acre per year in the short term, which, after reclamation, would decrease to 1.602 tons per acre per year in the long term. This base erosion rate remains constant under each alternative. The intensity of impacts from erosion would vary under each alternative based on the area of projected surface disturbance. The intensity of impacts to soil resources from surface-disturbing activities under all alternatives is anticipated to be similar to the reasonable foreseeable actions identified in Appendix T.

Actions such as mineral resources development, motorized vehicle use, road construction, and recreation that disturb the soil surface can increase runoff and erosion, resulting in adverse impacts. The BLM utilizes various methods to minimize impacts to soil resources under all alternatives. BMPs, watershed enhancement projects, conservation practices, Storm Water Discharge Plans, and reclamation plans are designed to reduce impacts to soil, resulting in more successful reclamation, reduction in impacts during the time that soil is bare, as well as reduced runoff, soil erosion, and sediment yield. The BLM mitigates impacts from surface-disturbing and disruptive activities through the application of the *Wyoming BLM Standard Mitigation Guidelines for Surface-Disturbing and Disruptive Activities* (Appendix H).

Motorized vehicle use can compact the soil surface and remove vegetative cover that would protect soil from runoff events. Management that limits motorized vehicle use to existing roads and trails would prevent route proliferation and vegetation removal that may increase erosion. In addition,

management actions that restore plant communities would enhance soil resources by restoring infiltration, organic matter content, productivity, and reducing erosion.

Wild horses can adversely affect soils, especially in Herd Management Areas (HMAs) where concentrated year-round grazing can occur. Studies have shown that areas with wild horses experience increased compaction of the soil surface, especially in areas with finer-textured soils (Beever 2003; Beever 2006). Horse-occupied sites also have been shown to have a lower abundance of grass and shrub cover on rangeland compared to sites where horses have been removed (Beever 2006). Horses tend to use only a few trails to get water, which concentrates their movement and defecations and results in a greater impact to soil resources in these areas (Beever 2003). The impacts to soils from wild horses will likely be similar across all alternatives since the initial appropriate management levels for the HMAs do not vary.

Livestock, on the other hand, unless they are near a water source, tend to distribute themselves more uniformly across the landscape when grazing, thereby distributing the impacts. The BLM utilizes the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N) to protect and improve rangeland health, which is generally effective in managing the impacts to soils from livestock grazing.

Prohibiting the disposal of topsoil within the Planning Area would result in beneficial impacts to soil resources, because this management action would prevent the removal of soil at the startup of surface-disturbing activities or the loss of soil through disposals as a mineral materials resource via sale, permit, or free use to qualified entities.

Actions that restrict surface disturbance in the Planning Area occur under all alternatives and generally are considered to have a beneficial impact on soil resources. For example, withdrawals that close areas to operation of the public land laws would reduce the potential for impacts to soil from surface-disturbing activities.

Alternative A

Surface Disturbance

Projected short-term disturbance from all BLM actions under Alternative A would affect 136,415 acres, resulting in erosion rates of 568,166 tons per year. After reclamation, long-term erosion rates would average 25,167 tons per year. Standard BMPs and mitigation guidelines combined with the restrictions on development on slopes greater than 25 percent are generally effective in mitigating impacts to soil and water resources under normal conditions.

Resource Uses

Surface-disturbing activities associated with mineral development expose soils to increased erosion potential in both the short term and long term. With projected initial disturbance of 25,390 acres for mineral resource development, short-term erosion rates would average 105,749 tons per year under Alternative A (Appendix T). Once these sites are stabilized and reclaimed, erosion rates would drop to 20,776 tons per year. Increases in surface disturbance related to mineral development may result in a proportional increase in impacts to soils.

Alternative A designates 116,800 acres of BLM-administered surface land available for disposal. Uncontrolled surface-disturbing activity would adversely affect land transferred out of federal control. Alternative A withdraws the second most acreage from operation of the public land laws in the Planning Area. Land withdrawn from operation under the public land laws would reduce the potential for impacts to soil from surface-disturbing activities. The greatest long-term disturbance from ROW

development would be from roads and other ROW facilities (typically associated with oil and gas facilities and mineral development). The projected initial erosion rate from disturbance associated with other ROW facilities would be 875 tons per year, which would decrease to 336 tons per year after reclamation. With the projection of 1,966 acres of disturbance associated with road construction (primarily related to oil and gas development and other local demand), short-term erosion would be 5,217 tons per year (Appendix T). Once new roads are stabilized, long-term erosion rates would average 2,608 tons per year.

Comprehensive travel and transportation management (CTTM) under Alternative A restricts motorized vehicle use in the majority of the Planning Area to existing roads and trails. The BLM anticipates an increase in motorized vehicle use in the Planning Area over the life of the plan. Increased motorized vehicle use on more user-created trails would accelerate degradation of the soil resource by removing vegetative cover and increasing erosion in more areas. Short-term disturbance associated with the creation of new roads and trails in areas open to cross-country motorized travel is predicted to disturb 1,233 acres, with erosion rates of 5,135 tons per year. Once these areas are stabilized, long-term erosion rates would average 1,338 tons per year (Appendix T).

Most of the Planning Area would remain open to livestock grazing under this alternative. Concentrated herbivory can result in adverse impacts when adequate vegetation does not remain to protect the soil resource. Excessive vegetation removal can cause soil compaction that reduces infiltration, increases runoff, and hampers reclamation. Livestock grazing management under Alternative A provides for protection or enhancement of other resource values, which would provide beneficial impacts to soils. Alternative A prohibits the placement of salt, mineral, or forage supplements within ¼ mile of water, wetlands, riparian areas, and reclaimed or reforested areas, which would reduce vegetation removal and soil compaction from concentrated livestock grazing. Rangeland improvement projects, including spring development, pipeline development, reservoir/pit development, fence development, well development, and reservoir maintenance development, are predicted to result in an initial disturbance of 370 acres and erosion rates averaging 1,541 tons per year (Appendix T). Revegetation would usually occur within several growing seasons and long-term erosion rates would average 34 tons per year.

Special Designations

Alternative A places constraints and restrictions on surface-disturbing and disruptive activities in certain special designation and other management areas where surface disturbance is minimized. Such areas, including Wilderness Study Areas (WSAs) (143,974 acres), Wild and Scenic River (WSR) eligible waterways (27,483 acres), and Areas of Critical Environmental Concern (ACECs) (71,297 acres), include restrictions that limit surface disturbance, resulting in beneficial impacts to soil resources within these areas. The Carter Mountain ACEC (10,867 acres) and Upper Owl Creek ACEC (13,057 acres), designated under Alternative A, include specific management prescriptions designed to protect fragile soils.

Resources

Fire and fuels management may have an adverse impact as well as a beneficial impact on soil resources. Fire in the Planning Area can affect soils in the short term by removing vegetation and exposing soils to water and wind erosion. Under certain conditions, intense fires can create hydrophic soil conditions (i.e., resistance to water infiltration), whereby runoff and erosion are increased. Wildfires in the Planning Area are estimated to result in 117,620 acres of surface disturbance, which is not anticipated to vary by alternative, and an average erosion rate of 489,887 tons per year. In the long term, however, provided vegetative recovery is successful, fire can have a beneficial effect on soil resources by reducing long-term erosion and the risk of catastrophic fire.

Suppression and rehabilitation activities can also have the potential to affect the soil resource in both the short and long term. Activities such as firebreak construction, clearing vegetation, and use of heavy equipment would disturb the soil surface and increase erosion in the short term. For example, fire lines constructed during suppression efforts can channelize surface runoff, which can result in gully erosion. In the long term, however, successful stabilization efforts can increase cover with a subsequent reduction in the natural rate of erosion.

Alternative A utilizes wildland fire to restore fire-adapted ecosystems and to reduce hazardous fuels. The BLM anticipates that fire management would result in 40,000 acres of short-term disturbance from prescribed fire and 30,000 acres of short-term disturbance from mechanical fuels treatment on BLM-administered land in the Planning Area (Appendix T). This disturbance would result in an average erosion rate of 166,600 tons per year for prescribed fire and 124,950 tons per year for mechanical fuel treatments. The BLM does not anticipate long-term surface disturbance or associated erosion from prescribed fire or mechanical fuels treatments following reclamation.

Management actions under Alternative A designed to protect wildlife and special status species habitat from the impacts of surface-disturbing and disruptive activities also would protect soil resources from these activities. Management actions such as applying no surface occupancy (NSO) restrictions within big game crucial winter range and applying a controlled surface use (CSU) stipulation within ¼ mile of occupied greater sage-grouse leks would reduce the chance of erosion. However, prohibiting livestock grazing, although not a surface-disturbing activity, in certain areas such as in elk parturition habitat could have the effect of concentrating livestock grazing and degrading the soil resource in other areas. Vegetation management in crucial wildlife habitat is an additional beneficial impact for soil resources.

Proactive Management

Existing management actions intended to protect soils include analyzing all surface-disturbing and disruptive activities for suitability and impact, seeding areas impacted by surface-disturbing activities, and reestablishing vegetative cover within 5 years of initial seeding. The use of native plant species under Alternative A would not have a substantial impact on runoff and erosion. Under Alternative A, the BLM considers topsoil salvage and the stabilization of heavily eroded or washed out roads on a case-by-case basis. The BLM also implements watershed improvement practices to reduce sediment loadings in streams. This includes seeding, riparian/stream restoration, travel management, head cut control and sediment capture and containment projects. This alternative requires stabilization of existing watershed improvement projects where they have failed to promote, enhance, or improve watershed stability. However, Alternative A does not require reclamation plans. Reclamation plans can improve the effectiveness of the reclamation process and reduce the risk of additional soil degradation. Due to the increase in off-road motorized vehicle use in the Planning Area, two-track trails and unimproved roads are a substantial source of runoff and sediment. The lack of mandatory action to stabilize heavily eroded or washed out roads increases the potential for degradation of watershed health.

Alternative B

Surface Disturbance

Alternative B includes the least acreage subject to surface-disturbing activities through management actions for other resources; therefore, surface disturbance under this alternative would result in the least impact to soils compared to the other alternatives. Under this alternative, projected short-term disturbance from all BLM actions would affect 73,919 acres. Erosion rates for short-term disturbance under Alternative B would be 307,873 tons per year. Following reclamation of disturbed sites, the

projected long-term erosion rates would average 17,432 tons per year, which is less than the other alternatives.

Alternative B includes the greatest restrictions on surface-disturbing activities, compared to the other alternatives, for the protection of other resources such as special designations, crucial wildlife habitat, and recreation management areas.

Resource Uses

With the projected initial disturbance of 17,327 acres for mineral resource development, short-term erosion rates would average 72,167 tons per year under Alternative B (Appendix T). After these sites are stabilized and reclaimed, erosion rates would drop to 9,960 tons per year, the lowest of all alternatives.

Under Alternative B, the impacts of disposal and retention would be similar to those described under Alternative A. Under Alternative B, 24,267 acres are identified for disposal (including disposal for specific uses), which is less than under Alternative A. Disposing of potentially less land may decrease the potential for uncontrolled surface-disturbing activities and soil resource degradation. Withdrawals under Alternative B would close the most land to operation under the public land laws relative to the other alternatives. The projected initial erosion rate from disturbance associated with other ROW facilities (typically associated with oil and gas facilities and mineral development) would be 396 tons per year, which would decrease to 152 tons per year after reclamation, which is less than the other alternatives. With the projection of 1,229 acres of disturbance associated with road construction (primarily related to oil and gas development and other local demand), short-term erosion would be 3,261 tons per year (Appendix T). Once the roads are stabilized, long-term erosion rates would be 1,632 tons per year, the least of all alternatives.

Alternative B designates the majority of the Planning Area as limited to designated road and trails for motorized vehicle use, reducing the potential for new route proliferation and providing more protection to soil resources than the other alternatives. Compared to Alternative A, which designates the most acreage in the Planning Area as limited to existing roads and trails, and although inappropriate use of vehicles may still occur in areas limited to designated roads and trails, Alternative B would allow greater management control over motorized vehicle use and help limit the impacts to soils. Alternative B also designates the largest area as closed to motorized vehicle use compared to alternatives A, C, and D. Short-term disturbance associated with new road and trail creation in areas open to cross-country motorized travel under Alternative B is predicted to disturb 2,776 acres, with erosion rates of 11,562 tons per year (Appendix T). Once these areas are stabilized, long-term erosion rates would average 1,711 tons per year, which is higher than Alternative A, but lower than alternatives C and D.

Under this alternative, a large portion of the Planning Area is closed to livestock grazing (1,988,927 acres). A ½-mile buffer prohibiting the placement of salt, mineral, or forage supplements near water, wetlands, riparian areas, and reclaimed or reforested areas would provide greater protection of soil in these areas compared to the other alternatives. Short-term erosion rates associated with rangeland improvement projects in the Planning Area would average 771 tons per year based on an initial disturbance of 185 acres. After reclamation, long-term erosion rates would average 17 tons per year.

Special Designations

Compared to all other alternatives, Alternative B places more restrictions on surface-disturbing activity within special designations and other management areas where surface disturbance is minimized. Many of these areas designated and managed under Alternative B, including ACECs (299,954 acres), Special Recreation Management Areas (SRMAs) and Recreation Management Zones (RMZs) (936,386 acres), WSAs (143,974 acres), WSR suitable waterways (27,483 acres), and lands with wilderness characteristics

(LWCs) designated as Wild Lands (571,288 acres), include restrictions such as NSO, mineral withdrawals, and prohibitions on surface-disturbing activities that would, subject to applicable laws and regulations, result in long-term beneficial impacts to soil resources within these areas. Similar to Alternative A, the Carter Mountain ACEC (16,573 acres) and Upper Owl Creek ACEC (32,777 acres) include specific management prescriptions designed to protect fragile soils. However, the beneficial impact would be greater under Alternative B because the two ACECs include a combined additional 25,426 acres more than the same two ACECs under Alternative A.

Resources

Fire and fuels management under Alternative B utilizes wildland fire and other vegetative treatments to restore fire-adapted ecosystems for natural resource systems and to reduce hazardous fuels. The BLM anticipates that management will result in 20,000 acres of short-term disturbance from prescribed fire and 5,000 acres of short-term disturbance from mechanical fuels treatment on BLM-administered land in the Planning Area (Appendix T). This would result in an average erosion rate of 83,300 tons per year for prescribed fire and 20,825 tons per year for mechanical fuel treatments, the least for all alternatives.

Alternative B applies greater restrictions on surface-disturbing activities designed to protect wildlife and special status species habitat than alternatives A, C, or D and therefore has a greater beneficial impact on soil resources. Vegetation management in crucial wildlife habitat is an added beneficial impact for soil resources.

Proactive Management

Of all the alternatives, the management prescriptions on lands administered by the BLM under Alternative B are the most protective of soil resources. Proactive management actions under this alternative include taking inventory of erosion rates and analyzing impacts from surface-disturbing activities by mapping soils, collecting samples, and evaluating current conditions. Site-specific data would result in better project design, BMP implementation, and better reclamation.

Proactive management also includes reestablishing native plant communities in disturbed areas, requiring topsoil salvage for all surface-disturbing activities, and requiring photo point monitoring of all channel crossings and all surface disturbance greater than ½ acre. The BLM would improve watershed health through the development of watershed improvement practices including seeding, riparian/stream restoration, travel management, head cut control and sediment capture and containment projects in cooperation with local governments and by stabilizing watershed projects if they are no longer meeting source objectives to prevent the release of stored sediment. Protecting watershed health will help to reduce the incidence of runoff and erosion.

Successful reclamation efforts following surface disturbance reduce the chance of long-term impacts to soil. Under Alternative B, higher reclamation standards and greater proactive management would improve reclamation success. Requiring reclamation plans before any authorized surface-disturbing activity leads to more successful reclamation efforts, which would benefit soils. A temporary protective surface treatment (such as mulch, netting, or tackifiers) used for the reclamation of all mechanically disturbed areas would, on average, reduce erosion rates in the short term by 2.97 tons per acre per year in these areas. Alternative B requires a more stringent reclamation standard than the other alternatives by requiring 50 percent pre-disturbance of desired vegetative cover within three growing seasons and 80 percent pre-disturbance vegetative cover within 5 years of initial seeding. While providing a beneficial impact to soils by reestablishing vegetative cover, the use of native plant species in disturbed areas would not have a substantial impact on runoff and erosion.

Alternative B mitigates the impacts to soil from the increase in off-road motorized vehicle use in the Planning Area by closing and reclaiming eroded roads and trails if alternative roads and trails are available and stabilizing or relocating these roads and trails if alternative routes are not available. Applying proactive management actions under this alternative would provide the most beneficial impacts to soils of any alternative.

Alternative C

Surface Disturbance

Alternative C places the fewest restrictions on resource uses with the result that more acreage is subject to surface-disturbing activities than the other alternatives. Under this alternative, projected short-term disturbance from all BLM actions would affect 245,783 acres, the most of any alternative. Erosion rates for short-term disturbance under Alternative C would be 1,023,686 tons per year. Following reclamation of disturbed sites, the projected long-term erosion rates would average 66,555 tons per year, over twice as high as under Alternative A.

As with the other alternatives, restrictions on surface-disturbing activities for the protection of other resources (e.g., water, biological resources, and special designations) may provide additional protection for soil resources.

Resource Uses

With the projected initial disturbance of 25,771 acres for mineral resource development, short-term erosion rates would be 107,336 tons per year under Alternative C. Once these sites are stabilized and reclaimed, erosion rates would decrease to 21,018 tons per year, slightly more than under Alternative A.

Alternative C identifies the most acreage of all alternatives for disposal of BLM-administered surface lands (117,961 acres), resulting in greater uncertainty of future land uses and impacts to soil. Alternative C designates the fewest acres for withdrawal from the operation of the public land laws than the other alternatives, which increases the potential for adverse impacts to soil. The projected erosion rates from surface disturbance associated with other ROW facilities (typically associated with oil and gas facilities) are the highest of any alternative, averaging 970 tons per year in the short term and 373 tons per year in the long term. With the projection of 4,638 acres of surface disturbance associated with road construction (primarily related to oil and gas development and other local demand), short-term erosion rates would be 12,307 tons per year (Appendix T). Once the roads are stabilized, long-term erosion rates would average 6,154 tons per year, the highest of all alternatives.

Alternative C limits motorized vehicle use to existing roads and trails in the majority of the Planning Area, resulting in similar impacts as those described under Alternative A. Alternative C closes the fewest number of acres to motorized vehicle use and opens more acreage to cross-country motorized travel than any other alternative, resulting in the least protection of soil resources in sensitive areas. The areas open to cross-country motorized travel, such as Basin Gardens Play Area SRMA and Lovell Lakes "Motocross" area, would have a higher probability of erosion and long-term soil degradation than areas that close or limit motorized vehicle use. Partly because more acreage is open to cross-country motorized travel, short-term disturbance associated with the creation of new roads and trails for recreational purposes (12,907 acres) is projected to be higher under Alternative C than under the other alternatives. The creation of these roads and trails would result in erosion rates of 53,758 tons per year in the short term, the highest of all alternatives (Appendix T). Once these areas stabilize, long-term erosion rates would average 20,401 tons per year.

Under Alternative C, the majority of the Planning Area is available for livestock grazing. The BLM manages livestock grazing to optimize commodity production while meeting rangeland health standards but not specifically to enhance other resource values. Management under Alternative C also does not prohibit the placement of salt, mineral, or forage supplements, and increases the potential for adverse impacts to soil near water, wetlands, riparian areas, and reclaimed or reforested areas. This alternative focuses on rangeland improvement projects to mitigate impacts to resources. Short-term erosion rates associated with rangeland improvement projects in the Planning Area would be 3,082 tons per year based on an initial disturbance of 740 acres. After reclamation, long-term erosion rates would decrease to 74 tons per year, higher than the other alternatives.

Special Designations

Compared to other alternatives, Alternative C prescribes fewer restrictions on surface-disturbing and disruptive activities for a smaller number of special designations and other management areas where surface disturbance is minimized. Alternative C designates two ACECs (12,144 acres) which provide protection for the soil resource by limiting surface-disturbing and disruptive activities. Alternative C also manages the 10 WSAs (143,974 acres) in accordance with the *Interim Management Policy and Guidelines for Lands Under Wilderness Review: Update Document H-8550* (IMP) to maintain the non-impairment standard, and therefore provides protections for soils within these areas. Alternative C, in contrast to Alternative B, does not include special management prescriptions for WSR eligible waterways or LWCs that would provide additional protection for soils.

Resources

Fire and fuels management under Alternative C utilizes wildland fire and other vegetative treatments to restore fire-adapted ecosystems, to enhance forage for commodity production, and to reduce hazardous fuels. The BLM anticipates that management would result in 80,000 acres of short-term disturbance from prescribed fire and 60,000 acres of short-term disturbance from mechanical fuels treatment on BLM-administered land in the Planning Area (Appendix T). This would result in an average erosion rate of 333,200 tons per year for prescribed fire and 249,900 tons per year for mechanical fuel treatments, which are the highest erosion rates of all alternatives. In comparison, wildland fires in the Planning Area are estimated to result in 117,620 acres of disturbance, which is not anticipated to vary based on alternative, and an average erosion rate of 489,887 tons per year.

In contrast to the other alternatives, Alternative C applies fewer management restrictions on surface-disturbing and disruptive activity designed to protect wildlife and special status species. The absence or reduction of these restrictions results in greater potential for adverse impacts to soil resources.

Proactive Management

Proactive management under Alternative C is similar to Alternative A. However, unlike Alternative A, Alternative C reestablishes plant communities in disturbed areas to increase commodity production and requires reclamation plans on a case-by-case basis. The use of reclamation plans can increase the use of BMPs to better protect the soil resource and improve overall reclamation success. Alternative C sets a lower vegetation restoration standard than alternatives B and D. Alternative C requires 30 percent desired vegetative cover within three growing seasons compared to Alternative A, which does not specify the degree of cover to be restored. Low vegetative cover increases the chance of erosion and nutrient loss, which increases the difficulty of achieving successful final reclamation. On a case-by-case basis, watershed projects are stabilized if they are no longer meeting resource objectives, resulting in a beneficial impact to soil and watershed health by preventing the release of stored sediment. Other management actions beneficial to soil resources under Alternative C include stabilizing heavily eroded or

washed out roads and collecting site-specific data through mapping, collecting, and evaluating current erosion conditions on a case-by-case basis. Site-specific data would result in better project design, BMP implementation, and better reclamation.

Alternative D

Surface Disturbance

Impacts to soil from surface disturbance under Alternative D are projected to be greater than under alternatives A and B but less than under Alternative C. Projected short-term disturbance from all BLM actions would affect 140,507 acres (Table 4-1), resulting in an erosion rate of 585,214 tons per year. After reclamation, the long-term erosion rate would average 29,546 tons per year, which is slightly greater than Alternative A.

Resource Uses

Under Alternative D, the projected amount of surface disturbed by activities associated with minerals development (24,896 acres) is greater than under Alternative B but less than under alternatives A and C. The predicted average erosion from surface disturbance would be 103,692 tons per year in the short term, reducing to 20,179 tons per year after reclamation and stabilization. Proper reclamation in accordance with an approved reclamation plan, stipulations, or measures, which are required under Alternative D, would help improve reclamation success and reduce long-term impacts to soil.

Alternative D identifies 66,022 acres for disposal of BLM-administered surface lands, more acres than under Alternative B but fewer than under alternatives A and C. Impacts to soil resources in areas disposed from federal ownership would be similar to those described for Alternative A. The erosion rate predicted from disturbance associated with other ROW facilities and road construction would be the same as under Alternative A.

CTTM under Alternative D would protect soil from motorized vehicle use on more acreage than alternatives A and C through closures and limiting motorized vehicle use to designated roads and trails, but would also designate the second most acreage as open to cross-country motorized travel (5,941 acres). Partly because more acreage is open to cross-country motorized travel and partly due to a higher projected rate of yearly new road and trail creation under this alternative, disturbance associated with the creation of new roads and trails (5,820 acres) is projected to be higher under Alternative D than under alternatives A and B but less than under Alternative C. Creating these roads and trails would result in erosion rates of 24,240 tons per year in the short term and 6,313 tons per year in the long term (Appendix T).

Livestock grazing management is conducted in a similar fashion as Alternative A, resulting in similar impacts to soils. Alternative D is projected to disturb the same acreage from rangeland improvement projects as Alternative A and result in the same amount of erosion.

Special Designations

Alternative D designates several special designations and other management areas that would minimize surface disturbance and provide a beneficial impact to soil in these areas. Management prescriptions for ACECs (103,128 acres), WSAs (143,974 acres), and LWCs designated as Wild Lands (52,485 acres) can provide additional protection for soils from surface-disturbing activities. Alternative D protects a greater area in these special designations from surface-disturbing activities than alternatives A and C, but less than Alternative B. Management of certain SRMAs would only allow surface-disturbing activities if the impacts could be avoided or mitigated, thereby reducing the impacts to soil in the long term. Similar to

Alternative C, Alternative D does not include special management prescriptions for WSR eligible waterways that would provide additional protection for soils. Similar to Alternative A, the Carter Mountain ACEC (10,867 acres) and Upper Owl Creek ACEC (13,057 acres) include specific management prescriptions designed to protect fragile soils.

Resources

Fire and fuels management under Alternative D would utilize wildland fires and other vegetation treatments to restore fire-adapted ecosystems, reduce hazardous fuels, and accomplish resource management objectives. Under Alternative D, prescribed fire and mechanical fuels treatments are projected to disturb the same acreage as under Alternative A and would result in the same erosion rate and similar impacts to soils.

Management designed to protect fish and wildlife, special status species, and other biological resources would provide benefits to soil by limiting surface-disturbing activities and other actions that could degrade soil health. The beneficial impacts would be similar to those described under Alternative A except that several areas would require avoidance of surface-disturbing activities. In these areas, surface-disturbing activities would be prohibited unless the impacts could be mitigated, thereby limiting long-term adverse impacts.

Proactive Management

Overall, proactive management actions under Alternative D would provide soil resources with greater protection and improve reclamation efforts more than alternatives A and C but less than Alternative B. Stabilization of existing watershed improvement projects would prevent the release of stored sediment and the degradation of watershed health. In disturbed areas, the reestablishment of healthy native or desired plant communities (DPCs) would benefit soils by increasing vegetative cover and reducing runoff. Soil would also benefit from the reclamation standards under Alternative D, which considers final reclamation to be achieved if conditions are equal to or better than pre-disturbance site conditions. When appropriate for the site and situation, Alternative D would require temporary protective surface treatments such as weed-free mulch, matting, netting, or tackifiers to facilitate the reclamation of disturbed areas, which would result in beneficial impacts similar to those described for Alternative B.

4.1.4 Water

This section summarizes beneficial and adverse impacts to surface water quality and quantity, and groundwater quality and quantity. In addition, the section describes the differences between direct and indirect impacts and short- and long-term impacts.

Surface Water Quality

Adverse impacts to water quality are those that result in a violation of state water quality standards or degrade a designated use. Management actions that permit surface-disturbing activities that contribute to offsite erosion and sediment delivery are considered adverse impacts. Beneficial impacts to surface water quality result from management actions that improve water quality or minimize, reduce, or prevent offsite erosion or the discharge of supplemental water that is of lower quality than the ambient water quality of the receiving water. For example, management actions that stabilize watershed projects no longer meeting resource objectives or that seed degraded portions of watersheds would result in beneficial impacts to surface water quality.

Direct impacts to surface water quality are those that degrade the ambient water quality of surface waters in the Planning Area. For example, management actions that modify drainages, such as altering

the number of linear water crossings or the distribution and condition of wetlands and riparian areas, would result in direct impacts to surface water quality. Indirect impacts are those that disturb soil in a watershed, especially highly erodible soil, as this leads to increased sedimentation.

Long-term impacts to surface water quality are those that result from bare soil or established point discharges that increase sediment loads or degrade water quality. Short-term impacts include exceedances of state water-quality standards mitigated within required timeframes, or surface disturbances temporarily affecting water quality that are reclaimed immediately after a temporary use.

Surface Water Quantity

Impacts to surface water quantity result from management actions that reduce or supplement streamflows and may be either beneficial or adverse, depending on the quantity and the location of the withdrawal(s) and/or discharge(s).

Direct impacts to surface water quantity result from management actions (e.g., vegetative and physical treatments, impoundments, retention and detention structures, etc.) that increase or decrease runoff, as well as from changes in the quantity of produced water discharged into the system. Direct impacts also result from adding or modifying diversions from the drainage system.

Indirect impacts to surface water quantity result from management that modifies the capacity of stream channels or result in changes to the amount of water reaching the stream system. For example, changes in the locations of roads that direct surface water runoff into drainages may increase or decrease the timing and amount of surface water flowing in the stream system. The distribution and condition of wetlands and riparian areas would indirectly result in changes to surface water quantity because they increase infiltration and delay peak flows.

Long-term impacts to surface water quantity are those that alter the amount of impervious surface in a drainage or change established discharges that alter supplemental streamflows (more than 5 years). Short-term impacts include uses that may temporarily affect water quantity, such as temporary impoundments or detention structures.

Groundwater Quality and Quantity

Change in the number of wells drilled in a given area, including domestic or municipal water supply wells, oil and gas wells, and water disposal or injection wells, result in direct impacts to groundwater quality and quantity. Other factors include the number and location of springs developed, whether there are water conservation efforts in an area, and the amount of water infiltration and recharge. Oil- or gas-well stimulation methods also can directly affect groundwater.

Indirect impacts to groundwater quality and quantity result from activities that modify recharge areas related to a groundwater system or systems. For example, activities that decrease vegetative cover, or increase runoff, can reduce infiltration of precipitation, thereby reducing recharge to groundwater aquifers.

Short-term impacts to groundwater are those resulting from any temporary or short-term use of groundwater—for example, temporary use of a well to supply water for drilling an exploratory gas well or for supplementing the water supply in a grazing allotment. Long-term impacts to groundwater quality and quantity can result from permanent oil and gas fields and production facilities constructed in recharge areas, or from landscape alterations that modify groundwater recharge. Such impacts can include wells that deplete an aquifer through extraction of water, paved surfaces and compacted soils that decrease water infiltration, or wells used to inject water of similar quality (disposal wells) into the aquifer.

4.1.4.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Surface disturbance can affect surface water quality by increasing sediment transport, which can ultimately be transported to streams or other surface waters and by reducing infiltration, which affects surface water and groundwater quality, quantity, and timing.
- Actions that provide protection for the soil and vegetation resources will generally mitigate impacts on the water resource as well.
- Soils that are the most susceptible to erosion are the most likely to adversely affect surface water quality if disturbed. The amount of sedimentation is determined by many factors, including the amount of disturbed surface, the type of soil, the amount and timing of water sufficient to create overland flow, the proximity to established channels, the density and vigor of the vegetative community, the buffering capacity of land over which the water would flow, and the effectiveness of erosion-control measures, such as BMPs.
- The extent of two-tracks and unsurfaced roads (i.e., those without gravel or any other added surface material) is an indicator of the quantity of erosion and sediment delivery that may impact surface water quality within each watershed (Furniss et al. 2000).
- Produced water generated from oil and gas development adds to surface water flows and can supplement streamflows. It is assumed legal water rights are established according to the requirements of the state engineer if livestock producers or other land users choose to utilize this water.
- Mineral development is the principal activity with a potential to impact shallow groundwater quality and quantity. Locations in the Planning Area with depths to groundwater of less than 100 feet are considered the most likely to be impacted by mineral development. The shallower the depth to water, the more sensitive an aquifer is to contamination (Wyoming Geographic Information Science Center 1998).
- The state of Wyoming has primacy regarding water. This includes water quality standards and water rights. The BLM may use water as an indicator or management tool, but it does not directly manage water.
- The principal sources of surface disturbance from mineral development are roads and well pads for oil and gas and the disturbance created by solid mineral mining.
- Livestock usually affect soil less than other developments, but the tendency for livestock to concentrate in riparian areas and in the proximity of open water while simultaneously affecting riparian vegetation may increase loading of fecal bacteria and nitrate (NO_3) to surface waters, and may increase erosion and sedimentation. In cooperation, consultation, and coordination with permittees/lessees, cooperators, and other stakeholders, the BLM would develop and implement appropriate livestock grazing management actions to enhance rangeland health, improve forage for livestock, and meet other multiple use objectives by using the *Wyoming Guidelines for Livestock Grazing Management*, other appropriate BMPs, and development of appropriate range improvements.
- Herbivory use is typically disproportionately higher in riparian/wetland communities than in upland communities. Improper or unmanaged herbivory can adversely impact these areas throughout the year, but surface impacts (due to hoof action) are generally greater in the spring and early summer, when soils are wet and, therefore, more vulnerable to compaction and stream banks are more vulnerable to sloughing. Livestock, especially cattle, tend to congregate

in these communities during the hot season (mid to late summer). While stocking rates for an allotment or pasture may be low to moderate, the utilization levels in riparian/wetland areas can be high.

- Substantial disturbance to soil, including compaction of soil or changes in vegetative cover, would increase water runoff and downstream sediment loads and would lower soil productivity, thereby degrading water quality, channel structure, and overall watershed health. Several factors influence the degree of impacts attributed to any one disturbance or series of disturbances, including location within the watershed, time and degree of disturbance, existing vegetation, and precipitation.
- Changes in channel geomorphology due to activities may be detrimental to current designated uses. Sediment in channels is necessary for maintaining channel geomorphology and building riparian systems. Most channel systems achieve a channel form in equilibrium to the water and sediment being naturally supplied to it and generally respond to changes in sediment loads or streamflows by changing the channel form.
- Changes in water quality for surface waters, such as increases in pollutants or physical parameters (e.g., temperature), may degrade habitat used by aquatic life and may affect other designated uses (e.g., stock-watering, irrigation, and drinking water supplies).
- The BLM policy prohibiting the mixing of chemicals within 500 feet of open water (BLM Handbook H-9011) would reduce the likelihood of chemical spills from federal actions contaminating surface waters.
- Because the state of Wyoming must comply with federal laws, compliance with state laws includes compliance with federal rules and regulations, including the Clean Water Act, Safe Drinking Water Act, and others. Therefore, it is assumed that any discharged water would meet water quality standards at the point of discharge.
- As populations expand in the area, disturbances that affect water in the Planning Area will most likely continue to expand.
- Actions that provide protection for the soil and vegetation resources will generally mitigate impacts on the water resource as well.
- This analysis uses the WEPP model to calculate the runoff amounts and erosion rates used throughout this section. WEPP simulates the conditions that affect runoff and erosion, such as the amount of vegetation canopy and soil water content, to estimate runoff averages and erosion rates. For a more detailed description of the WEPP model and a list of the assumptions and parameters used in the analysis, see Section 4.1.3 *Soil* and Appendix V. All erosion rates and runoff amounts calculated using the WEPP model for this section were calculated using the same assumptions and input parameters that were used for Section 4.1.3 *Soil* and as described in Appendix V.

4.1.4.2 Summary of Impacts by Alternative

Adverse impacts to surface and groundwater quality and quantity include increased erosion and sediment loading in streams and may result from a variety of resource programs including soils management, minerals development, management of fish and wildlife, motorized vehicle use, and livestock grazing. Reclamation and other management activities that increase vegetative cover result in beneficial impacts to water resources. Alternatives that result in more long-term surface disturbances and stipulate fewer restrictions on resource uses that might affect water resources are anticipated to result in the greatest overall impact to water. Alternative C would result in the greatest adverse impacts

to water resources due to the greatest projected surface disturbance and the fewest resource use restrictions. Although it would allow more long-term disturbance than Alternative A, Alternative D may result in fewer long-term adverse impacts to water resources due to increased reclamation standards and requirements for mitigation under this alternative. Alternative B would result in the fewest adverse impacts to water resources due to the comparatively smaller amount of projected surface disturbance and greater number of resource use restrictions under this alternative. Impacts to groundwater quality may result from produced water discharge where oil and gas wells are in areas with shallow groundwater. Alternative C is projected to result in the greatest number of new federal oil and gas wells, followed by alternatives A, D, and B (Appendix T).

4.1.4.3 Detailed Analysis of Alternatives

The following analysis focuses on potential short-term and long-term impacts to surface water and groundwater quality and quantity as a result of allowable uses and management actions proposed under each alternative. The proposed management of the following resource programs has the highest potential to beneficially or adversely affect water resources: locatable minerals, oil and gas (including, but not limited to the handling of produced water), soils (including restoration of healthy plant communities), fish and wildlife, CTTM, livestock grazing, and ACECs and other special designations. Other resource programs that have the potential to affect water resources include recreation (particularly the recreational use of OHVs), ROW improvements, watershed enhancement, invasive species, and forests, woodlands, and forest products (though these activities are usually small scale and do not totally denude the surface or alter root masses). Emphasis on the *Wyoming Standards for Healthy Rangelands* (Appendix N) would moderate impacts to water resources.

The principal factors used to differentiate between alternatives are the acres of projected surface disturbance for each alternative and the limitations of allowable uses and management actions. Alternatives with higher projected disturbance areas may lead to greater potential impacts to surface and groundwater (as described below under Impacts Common to All Alternatives). Similarly, greater or fewer allowable uses under an alternative would lead to a similar change in the potential for impacts to surface and groundwater. Due to the programmatic nature of the RMP alternatives, the timing and specific location of project actions that may affect resources are not defined. Alternative A is the primary point of comparison for all other alternatives.

Impacts Common to All Alternatives

Surface Water Quality Impacts

Actions that remove vegetation and loosen surface soil may cause surface runoff, resulting in soil erosion and sedimentation in the surface water system. Eroded soil that reaches surface water channels is a principal source of impaired surface water quality. The amount of sediment delivered to a stream depends on many factors (e.g., slope length and gradient, vegetative cover and type, and density of the drainage network), all of which may result in deposition of the sediment before it reaches a drainage (also called buffering). For example, large runoff events can lead to gully erosion, which can deliver large amounts of sediment in a small period.

Analysts used the WEPP analysis model, described in Section 4.1.3 *Soil* of this chapter, to estimate average runoff as a result of surface disturbances in the Planning Area. Analysts used the same assumptions they used to estimate soil erosion (see Section 4.1.3 *Soil* and Appendix V) to calculate the mean annual average runoff. The WEPP model estimates that areas affected by short-term surface disturbance would experience 0.34 inches of runoff per year. Once these areas are stabilized and

reclaimed, the average runoff would drop to 0.19 inches per year in the long term. In comparison, the WEPP model estimates that with no disturbance there would be only trace amounts of annual runoff. The scale of impacts from runoff is anticipated to vary by alternative based on the amount of surface disturbance anticipated under each alternative. Therefore, if there is more acreage of surface disturbance, there is more impact to water resources in the Planning Area.

The highest potential for long-term surface disturbance under all alternatives would result from the development of minerals, fire and fuels management, forest management, ROW development (roads, pipelines, and powerlines), motorized vehicle use, and recreational site development. Soil disturbance may also result from invasive species and pest management, motorized vehicle use, livestock and wildlife grazing, and the reclamation of disturbed areas. Alternatives with greater projected surface disturbance would result in increased sedimentation. Livestock and wildlife also may introduce fecal coliform, NO_3, and sediment to surface waters, which would contribute to water quality impairment.

Roads intercept surface water runoff on the landscape and often direct flows to drainages through ditches and culverts. If roads are unsurfaced, runoff flowing down a road often picks up sediment that is then deposited in the surface water system at stream crossings or at culverts and water bars. Alternatives that increase the density of roads in a watershed, especially unsurfaced roads, may increase sedimentation. Roads may also act as conduits for directing contaminants from vehicles and resource management activities (e.g., pesticide applications) into the surface water system (Furniss et al. 2000).

Short-term and long-term surface disturbance (e.g., from oil and gas and other minerals development, or travel and transportation management) and herbivory within the Planning Area also may affect surface water quality. Those watersheds with the greatest proportion of highly erodible soils have the most potential for contributing sediment to the surface water system with the presence of surface-disturbing activities. Under all alternatives, implementation, inspection, and maintenance of BMPs and the development and implementation of Stormwater Pollution Prevention Plans, as required under the WYPDES Stormwater Program would minimize sedimentation within watersheds. Water management plans for surface discharges of produced water would include reclamation strategies, mitigation, and monitoring to track changes in receiving channels and to minimize adverse impacts to watershed health. The BLM monitors rangeland health to determine livestock grazing management actions necessary to control erosion and other water-quality issues, such as contamination by fecal coliform bacteria, that affect surface waters. Proper management of livestock grazing can mitigate sediment delivery from erosion. WYPDES permits required by the state of Wyoming would regulate water quality changes associated with point source discharges (Wyoming DEQ 2004).

Management that reduces the production of sediment (e.g., through the enhancement of vegetative ground cover, proper livestock grazing management, or watershed improvement projects that reduce sediment transport into waterways) would have a beneficial impact on efforts to reduce sedimentation of Bighorn Lake. A 2009 study by the Bureau of Reclamation (BOR) and U.S. Army Corps of Engineers states that implementing BMPs in the Bighorn Basin could reduce the total sediment load entering this reservoir. The study notes, however, that such an approach might not be a practical way to achieve substantial sediment reductions given conditions in the area, noting that it would require considerable time to achieve results noticeable in the northern portion of Bighorn Lake that are important for recreational access (USACE and BOR 2009).

The Wyoming DEQ permits surface discharges of produced water from oil and gas wells through a WYPDES permit that requires compliance with specific water-quality standards. The quality of produced water discharged on the surface must be suitable for designated uses, such as agriculture and livestock, and cannot result in a violation of water-quality standards in the receiving stream. Produced water discharged into streams generally is hotter than the naturally occurring surface water and, although it is

subject to applicable Wyoming DEQ water quality standards, it can contain dissolved compounds that may affect water quality. Due to prolonged contact with the formations that contain oil and gas and contamination from chemical additives used in well drilling and production, this water may be more saline and contain higher concentrations of organic compounds (e.g., oil and other hydrocarbons) and various inorganic compounds than the receiving surface waters (Veil 2004). Adverse impacts on surface water quality from the introduction of these components of produced water would be minimized, but not eliminated, under all alternatives by following standard practices, BMPs, and guidelines for surface-disturbing activities. The properties of produced water can vary depending on the location of the producing well and the oil and gas formation, which will influence the application of BMPs and other measures intended to safeguard water quality.

Surface Water Quantity Impacts

When watersheds lack vegetation, surface infiltration into the soil decreases, causing more runoff to reach stream systems. As surface disturbance increases, so does the amount of bare soil, compacted soils, and possibly less-pervious areas in a watershed. As a result, more surface water runoff reaches streams in a shorter period of time, which increases the potential for sedimentation and the frequency of flooding or erosive velocities from high flows in channels. Conversely, activities such as reclamation would improve vegetative cover and would have a beneficial impact. Healthy vegetative cover increases infiltration of surface water flows, filters out sediment before it reaches drainages, reduces runoff, and lowers peak flows in the surface water system. Prescribed fire would reduce vegetation cover and increase sedimentation in the short term, but restoring fire-adapted ecosystems would increase vegetation cover and decrease the potential for large catastrophic fires in the long term. Concentrated grazing by livestock, wild horses in HMAs, and wildlife may contribute to soil compaction and damage to the vegetative cover and soil crust, thus increasing surface water runoff, erosion, and sedimentation.

Produced water from oil and gas wells sometimes is discharged to surface waters, thereby contributing to surface water flows. Beneficial impacts from produced water discharges include increased availability of surface water, although there may be adverse impacts from altering natural flow regimes, such as increased channel erosion. This would be the case under all alternatives, including Alternative B, under which the BLM would prohibit new surface discharge of produced water on public lands. Surface discharges previously authorized by the state of Wyoming would be allowed to continue.

Groundwater Quality and Quantity Impacts

Potential sources of groundwater contamination may come from point sources, such as chemical spills, chemical storage tanks (above ground and underground), industrial sites, landfills, household septic tanks, oil and gas well sites, oil and gas detention and retention ponds, well stimulation and hydraulic fracturing, and mining activities. Other possible sources of groundwater contamination may come from nonpoint sources, such as roadways and agricultural activities. Groundwater quality is most susceptible to pollution where the aquifer is shallow (within 100 feet of the surface), very permeable, or connected directly to a surface water system, such as river gravels. Produced water from oil and gas wells and, potentially, coalbed natural gas (CBNG) would have the greatest potential to affect groundwater quality and quantity where the wells are in areas with shallow depth to groundwater. Water produced from future CBNG wells in the Planning Area is expected to be of essentially the same quality and quantity as produced water from conventional or deep oil and gas wells.

Proactive Management Actions

Management actions that would protect or enhance water resources, regardless of the alternative, include, but are not limited to: using BMPs, watershed improvement and conservation practices, and

Stormwater Discharge Plans to reduce impacts; restoring healthy plant communities and vegetative cover after surface disturbance in a timely fashion; conforming BLM actions to Wyoming DEQ water quality standards, enforcement, and remediation; and participating in the development and implementation of local watershed management plans and/or total maximum daily loads (TMDLs) with interested stakeholders and the Wyoming DEQ. The BLM designates the Spanish Point Karst ACEC under all alternatives, which would protect important groundwater recharge areas from surface-disturbing activities and other resource uses that may affect water quality.

Alternative A

Surface Disturbance

The BLM projects approximately 15,710 acres of long-term surface disturbance from BLM-authorized actions and approximately 136,415 acres of short-term surface disturbance (Table 4-1). Surface-disturbing activities would result in adverse impacts to water quality due to erosion, runoff, sedimentation, and potential changes in the chemical characteristics of water resources. Erosion rates, calculated using the WEPP model (Appendix V), are estimated to be 568,166 tons per year in the short term. After reclamation, long-term erosion rates would average 25,167 tons per year. The BLM analyzes all surface-disturbing activities for suitability and potential impact, which may reduce adverse impacts from surface disturbances by allowing the BLM to impose additional mitigation to reduce erosion on some projects.

Resource Uses

Resource uses such as locatable minerals operations, oil and gas operations, travel and transportation management, and livestock grazing may result in both direct and indirect adverse impacts to water resources. Direct adverse impacts resulting from such activities include accidental chemical releases and water disposal. Under Alternative A, the BLM allows the aerial application of pesticides near water on a case-by-case basis subject to label requirements, which would result in potential but limited direct adverse impacts to water quality. Indirect adverse impacts may result from surface disturbance, soil erosion, and resultant sedimentation. Alternative A would result in new roads from ROW development and user pioneered roads in areas open to cross-country motorized travel (Appendix T). The amount of new roads would result in proportional adverse impacts to soils, described under Impacts Common to All Alternatives. The BLM conducts the least extensive monitoring of grazing allotments under this alternative, which may result in less documentation of impacts to water quality, compared to the other alternatives. Alternative A prohibits the placement of salt, mineral, or forage supplements within ¼ mile of water, which would reduce the potential for soil compaction and vegetation removal adjacent to waterways from concentrated livestock grazing.

Under Alternative A, the BLM authorizes new activities resulting in the surface discharge of produced water if it meets state of Wyoming water quality standards. As described under Impacts Common to All Alternatives, such discharges would result in adverse impacts to surface water quality through the addition of sediment, heat, and chemical compounds and to groundwater quality and quantity through aquifer contamination and drawdown. Such discharges could increase in-stream flow, thereby benefitting surface water quantity.

Special Designations

Special designations, such as ACECs, would restrict surface-disturbing activities and resource uses that may adversely impact water quality and quantity, which generally would result in beneficial impacts to water resources. Under Alternative A, ACECs, WSAs, and WSR eligible waterways would encompass 49,

22, and 89 miles of streams, respectively. Due to their size and management, special designations under Alternative A would result in the third-greatest beneficial impact to water resources, compared to the other alternatives.

Resources

Reclamation requirements to manage soil resources would result in beneficial impacts to water quality in the short term by reducing erosion and associated sedimentation, and water quality and quantity in the long term by reestablishing vegetation to reduce runoff. Under Alternative A, the BLM routinely seeds, or requires permittees and operators to seed, disturbed areas with native plant species or approved seed mixtures and reestablishes vegetative cover over disturbed areas within 5 years of initial seeding, but does not require temporary protective surface treatments for mechanically disturbed areas. The BLM considers stabilization of heavily eroded or washed-out roads as well as trail stabilization on a case-by-case basis. These management actions would result in beneficial impacts to soils and ultimately water quality under Alternative A.

Alternative A would result in disturbance from fuels treatments and prescribed fire that would result in adverse impacts to surface water quality and quantity, but the small area of these treatments and the use of BMPs would minimize these impacts. Alternative A would also result in long-term beneficial impacts from restoring fire-adapted ecosystems by reducing the potential for catastrophic fires that may cause greater adverse impacts to water resources.

Forests, woodlands, and forest products may result in adverse impacts to water quantity and quality under Alternative A. The BLM allows clear cuts of up to 300 yards in any direction under this alternative. Clear cuts would increase sedimentation from increased erosion and runoff in clear-cut areas and result in adverse impacts to water resources. Spur roads generally are closed after completion of timber management, allowing vegetation to return, which would minimize long-term impacts to water resources from erosion in these areas.

To protect fish habitat, the BLM applies an NSO restriction and prohibits unnecessary and unmitigated surface-disturbing activities within 500 feet of surface water and riparian areas. This management would reduce adverse impacts to water quality from oil and gas development.

Proactive Management

Proactive management actions under Alternative A that would result in beneficial impacts to surface water quality and quantity include implementing watershed improvement practices in Wyoming's Bighorn Basin water quality plans, encouraging the maintenance of natural flow regimes in streams supporting fisheries, and fencing streams and reservoirs as necessary. This alternative also benefits surface water quality and quantity by stabilizing existing failed watershed improvement projects to benefit watershed stability and by assessing erosion and soil stability during rangeland health evaluations.

Alternative B

Surface Disturbance

Over the long term, it is projected that BLM actions under Alternative B would disturb approximately 10,882 acres, the smallest area of disturbance of any alternative, and would result in 17,432 tons per year of soil erosion. Projected short-term surface disturbance would affect approximately 73,919 acres (Table 4-1), resulting in an average of 307,873 tons of erosion per year. Alternative B requires additional analysis of soils for erosion potential, and therefore more information to prevent erosion than the other

alternatives, by requiring mapping of the soils in areas to be disturbed and elsewhere on BLM-administered lands to a series level, collecting soil samples, and evaluating current erosion conditions. Unlike alternatives A and C and similarly to Alternative D, reclamation plans are required prior to surface-disturbing activities, increasing the chances for successful reclamation and reducing the chances for watershed decline. Compared to the other alternatives, surface-disturbing activities under Alternative B would reduce the potential for erosion and sedimentation in surface waterbodies resulting in less impervious surface to diminish groundwater recharge.

Resource Uses

Conservation measures under this alternative would improve water quality and quantity compared to the other alternatives by reducing erosion and sedimentation, and increasing infiltration. Under Alternative B, the BLM prohibits the aerial application of pesticides within ½ mile of aquatic habitats, which would result in the least potential for adverse water quality impacts, compared to the other alternatives. Alternative B would result in the least acreage of new roads from ROW development and user pioneered roads in areas open to cross-country motorized travel (Appendix T) with proportional adverse impacts to water quality described under Impacts Common to All Alternatives.

The BLM conducts the most extensive monitoring of grazing allotments, all those that do not meet the *Wyoming Standards for Healthy Rangelands* (Appendix N), which would result in the greatest beneficial impact to water quality by monitoring erosion. Alternative B prohibits the placement of salt, mineral, or forage supplements within ½ mile of water. The additional grazing constraints under Alternative B may reduce the potential for fecal coliform and NO_3 reaching surface waters when compared to the other alternatives. In addition, reduced grazing in riparian areas under Alternative B would reduce erosion and sedimentation in surface waters, and reduced well development would reduce groundwater withdrawals when compared to all other alternatives.

Alternative B places the greatest restrictions on motorized vehicle use in the Planning Area of any alternative, which would result in the least potential vegetation removal, soil compaction, and fewest water crossings and associated adverse impacts to water resources.

Additionally, new surface discharge of produced water on public lands is prohibited, which would result in fewer potential adverse impacts to surface water quality and groundwater quality and quantity, and fewer beneficial impacts to surface water quantity than alternatives A, C, and D.

Special Designations

Alternative B designates an additional eight ACECs, the Absaroka Front Management Area and all LWCs as Wild Lands to protect their wilderness characteristics. Under this alternative, ACECs, WSAs, WSR eligible waterways, the Absaroka Front Management Area, and Wild Lands would encompass 62, 22, 89, 38, and 91 miles of streams, respectively. The relative size and additional restrictions on surface-disturbing activities and resource uses in these areas would result in additional protection for surface and groundwater versus alternatives A, C, and D.

Resources

Alternative B would result in the least adverse impacts to water resources from short-term surface disturbance because it applies the most stringent requirements to minimize erosion. The BLM reestablishes native plant communities in disturbed areas; requires temporary protective surface treatments of disturbed areas, such as mulch, matting, netting, or tackifiers; requires interim and final reclamation of disturbed areas at the earliest feasible time; and closes or relocates heavily eroded or washed out roads and trails. Specifically, Alternative B requires the reestablishment of 50 percent of

pre-disturbance levels of desired vegetative cover within three growing seasons following surface disturbance and 80 percent within 5 years of initial seeding to prevent erosion.

Alternative B would result in the least disturbance from fuels treatments and prescribed fire. This disturbance would result in the least short-term adverse impacts to surface water quality and quantity, but the least long-term beneficial impacts of restoring fire-adapted ecosystems to reduce the potential for catastrophic fires.

Forests, woodlands, and forest products management practices under Alternative B would result in the least adverse impact to water resources. The BLM prohibits clear cuts and closes timber access and haul roads not required for existing uses, which would result in the least potential for erosion and sedimentation.

To protect fisheries and riparian/wetland areas, the BLM applies an NSO restriction and prohibits surface-disturbing activities within ¼ mile of riparian/wetland areas, any Wyoming Game and Fish Department (WGFD)-rated Class 1 or 2 waters, and many major rivers in the Planning Area. The BLM allows sediment reduction structures on a case-by-case basis. These management practices under Alternative B would reduce adverse impacts to water quality from oil and gas development the most, compared against the other alternatives.

Proactive Management

Under Alternative B, the BLM manages water resources with an emphasis on conservation. Proactive management actions under Alternative B that would result in beneficial impacts to surface water quality and quantity include completing a greater number of watershed enhancement projects; maintaining natural flow regimes in priority streams; and cooperating with adjacent landowners and managers to address impaired waterbodies on the state of Wyoming 303d list. Watershed improvement projects are stabilized to prevent release of stored sediment if the project no longer meets resource objectives. Proactive management actions under Alternative B would result in the greatest beneficial impacts to water resources, compared to the other alternatives.

Alternative C

Surface Disturbance

Long-term (41,545 acres) and short-term (245,783 acres) surface disturbance under Alternative C constitute more acreage than under the other alternatives (Table 4-1). Similarly, erosion rates under Alternative C are the highest among the alternatives. Erosion rates would average 1,023,686 tons per year in the short term and 66,555 tons per year in the long term, over twice as high as the long-term erosion rate under Alternative A. Additional analysis of soils for erosion potential, which is required under Alternative B, is performed only on a case-by-case basis under Alternative C, reducing the relative potential benefits to soils. The BLM requires reclamation plans only on a case-by-case basis, which may reduce the beneficial impacts of this action compared to Alternative B. Overall, Alternative C would have the greatest potential for erosion and sedimentation in surface waterbodies and result in the most impervious surface to diminish groundwater recharge.

Resource Uses

Alternative C would have the most acreage available for surface disturbance when compared to the other alternatives, and, therefore, the greatest potential for adverse impacts to water resources among the alternatives. Alternative C prohibits the aerial application of pesticides within 100 feet of aquatic habitats, which would result in less potential water quality impact from the associated chemicals than

alternatives A and D, but more than Alternative B. Alternative C would result in the most acreage of new roads from ROW development and user pioneered roads in areas open to cross-country motorized travel (Appendix T) with proportional adverse impacts to water quality described under Impacts Common to All Alternatives.

Potential impacts from grazing allotment monitoring would be similar to those under Alternative A. Alternative C allows the placement of salt, mineral, or forage supplements to maximize livestock use. This management action would result in the greatest potential impact to surface water from soil compaction and vegetation removal in riparian/wetland areas and from potential fecal coliform and NO_3 introduction, compared to all other alternatives.

Alternative C would allow the most motorized vehicle use in the Planning Area, including the most acreage open to cross-country motorized travel, which would result in the greatest potential vegetation removal, soil compaction, and water crossings and the associate impacts to water resources.

Alternative C would result in the same types of adverse and beneficial impacts from produced water disposals as described under Impacts Common to All Alternatives and Alternative A. However, expanded oil- and gas-well development projected under this alternative would result in the greatest intensity of these impacts, because groundwater withdrawals would increase compared to the other alternatives.

Special Designations

Except for travel restrictions, Alternative C proposes no specific management for the Absaroka Front Management Area, and also designates fewer ACECs than alternatives A, B or D, manages all WSR eligible waterway segments as unsuitable for inclusion in the National Wild and Scenic Rivers System (NWSRS), and does not manage any LWCs to protect their wilderness characteristics. Under Alternative C, ACECs and WSAs encompass 20 and 22 miles of streams, respectively. Generally, Alternative C would protect fewer areas from surface-disturbing activities than the other alternatives and therefore would be the least beneficial to surface and groundwater.

Resources

To prevent erosion, Alternative C requires 30 percent of pre-disturbance vegetation cover within three growing seasons of initial seeding. However, unlike Alternative B, Alternative C does not institute long-term vegetation cover requirements. Alternative C would result in the greatest adverse impact to water resources from short-term surface disturbance due to the greater acreage disturbed under this alternative and because it applies the second-least stringent requirements to minimize erosion. Alternative C does require reclamation plans on a case-by-case basis and stabilizes heavily eroded or washed out trails, which are a major source of runoff and sediment.

Alternative C would result in the greatest disturbance from fuels treatments and prescribed fire. This disturbance would result in the greatest short-term adverse impacts to surface water quality and quantity, but would have the greatest long-term beneficial impact of restoring fire-adapted ecosystems to reduce the potential for catastrophic fires.

Forests, woodlands, and forest products management practices under Alternative C would result in similar impacts to water resources as under Alternative A. The BLM allows clear cuts of up to 100 acres (more area than under Alternative A) and permits timber access and haul roads to remain open to meet other resource goals and objectives, maintaining impervious surfaces in these areas.

Alternative C applies similar NSO restrictions as Alternative A, but allows surface-disturbing activities in floodplains or riparian/wetland areas on a case-by-case basis. These management practices under

Alternative C would result in the greatest potential adverse impacts to water quality from oil and gas development, compared to the other alternatives.

Proactive Management

Under Alternative C, the BLM manages resources with an emphasis on resource uses. This alternative manages for the stabilization of watersheds through maintenance of existing watershed improvement projects. Under Alternative C, the BLM does not implement or develop new watershed improvement practices and only fences springs and their associated wetlands. Overall, proactive management actions under Alternative C would result in the fewest beneficial impacts to water resources, compared to the other alternatives.

Alternative D

Surface Disturbance

Under Alternative D, short- and long-term surface disturbance from BLM-authorized actions would disturb more acreage than alternatives A and B but less than Alternative C. Short-term surface disturbance of approximately 140,507 acres (Table 4-1) would result in an erosion rate of 585,214 tons per year. After reclamation, long-term surface disturbance (18,443 acres) would result in an erosion rate of 29,546 tons per year. Impacts from surface disturbance and erosion would be similar to those described under Alternative A although to a slightly higher degree due to more acreage of surface disturbance and greater erosion potential. However, more stringent reclamation standards and a requirement for reclamation plans, stipulations, or measures would provide a greater beneficial impact to surface water than both alternatives A and C by increasing the potential for successful reclamation and reducing the potential for long-term erosion. Soil and erosion evaluations are conducted in a similar manner as under Alternative A, although a slightly greater benefit may occur by conducting soil surveys as funds become available.

Resource Uses

Alternative D allows more resource use that would result in greater surface disturbance than alternatives A and B, creating a greater potential for watershed health degradation than those two alternatives. However, for certain resource programs, such as minerals development, Alternative D is projected to result in less disturbance than alternatives A and C. The BLM allows the aerial application of pesticides near water on a case-by-case basis, which would result in the same impacts as Alternative A. Alternative D is estimated to result in more new roads from ROW development and user-pioneered roads than alternatives A and B, resulting in proportional impacts.

Potential impacts from grazing allotment monitoring would be similar to Alternative A. Alternative D prohibits the placement of salt, mineral, or forage supplements within ¼ mile of water, reducing the potential for adverse impacts from concentrated livestock grazing similarly to Alternative A.

Alternative D opens more area to cross-country motorized travel than alternatives A and B, creating mores areas that could be adversely affected by concentrated motorized vehicle use through increased runoff and erosion.

Disposal of produced water under Alternative D would be authorized for new activities where compatible with other resource objectives and in consultation with stakeholders. The impacts, both adverse and beneficial, from produced water disposals would be the same as those described under Impacts Common to All Alternatives and Alternative A. However, because the number of new federal

wells projected under Alternative D would be less than under alternatives A and C, adverse impacts to water may be reduced overall.

Special Designations

Alternative D designates more acreage as ACECs than alternatives A and C, designates the Absaroka Front Management Area, and designates 52,485 acres of LWCs as Wild Lands, which would limit surface disturbance and adverse impacts to water in these areas. However, like Alternative C, Alternative D manages all WSR eligible waterway segments as unsuitable for inclusion in the NWSRS. Under this alternative, ACECs, WSAs, and the Absaroka Front Management Area would encompass 42, 22, and 44 miles of streams, respectively, which would provide greater beneficial impacts to water resources than alternatives A and C but less than Alternative B.

Resources

Alternative D would help to reduce erosion and subsequent sediment loading in streams by reestablishing native or desired plant communities in disturbed areas; requiring temporary protective surface treatments of disturbed areas when appropriate; requiring interim and final reclamation of disturbed areas at the earliest feasible time; and closing and reclaiming heavily eroded roads and trails if other stable roads and trails are available. While Alternative D does not specify timing requirements for achieving vegetative cover after surface disturbance, a potential adverse impact, it also does not consider successful final reclamation of vegetative cover to be achieved until conditions are equal to or better than pre-disturbance site conditions, a potential beneficial impact. Overall, measures to prevent erosion under Alternative D would result in a greater beneficial impact to surface water than under alternatives A and C, but less than under Alternative B.

Disturbance from fuels treatments and prescribed fire is projected to be the same as Alternative A with similar impacts.

In general, impacts from forests, woodlands, and forest products management would be similar to Alternative A. Spur roads would be assessed for closure on a case-by-case basis while clear cuts would be limited to 100 yards, potentially resulting in greater adverse impacts to surface water than under Alternative A by increasing runoff and erosion.

To protect riparian/wetland areas, the BLM applies an NSO restriction and manages to avoid surface-disturbing activities within 500 feet of riparian/wetland areas and up to ¼ mile if needed to protect sensitive resources, which would provide a greater beneficial impact to water than alternatives A and C. In addition, surface disturbance is avoided within ¼ mile of all WGFD-rated Class 1 or 2 fisheries, while all other fisheries are subject to a 500-foot buffer.

Proactive Management

Proactive management actions that would benefit surface water quality and quantity include developing watershed improvement practices; applying BMPs to reduce sediment loading; and fencing streams, wetlands, reservoirs, and riparian areas as necessary. The BLM conducts the same amount of watershed enhancement projects as under Alternative A while also stabilizing existing watershed improvement projects to prevent the release of stored sediment and protect watershed health. Similar to Alternative A, Alternative D would encourage the maintenance of natural flow regimes in priority streams supporting fisheries.

4.1.5 Cave and Karst Resources

This section describes impacts to cave and karst resources resulting from implementation of the alternatives. Adverse impacts to cave and karst systems result from management actions that alter, degrade, or destroy cave or karst systems and their features. Conversely, actions that result in data collection and preservation or establishment of cave and karst resources and their associated geological, biological, cultural, paleontological, hydrological, and/or educational values are considered beneficial impacts. Beneficial impacts from the designations of the Spanish Point Karst, Sheep Mountain Anticline, and Little Mountain ACECs are addressed in the Special Designations section of this chapter.

Direct impacts to cave and karst resources result from management actions that physically alter, damage, or destroy cave and karst systems, including their associated geologic features (speleothems) and biologic communities. In general, recreational uses of caves have the greatest potential to directly impact cave and karst resources.

Indirect impacts to cave and karst systems can result from actions that increase the accessibility of cave and karst areas, and therefore the probability of adverse impacts due to incompatible or excessive recreational use. Indirect impacts can also result from activities that can alter water quality (e.g., agriculture, pesticide application, pollution) when degraded water infiltrates into groundwater, thereby possibly altering the chemical and biological environment of cave and karst systems.

4.1.5.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Cave and karst resources are abundant within the Bighorn Basin. Thirty-two caves are known to exist within the Planning Area, 19 of which are considered significant for their biological, cultural, geological/mineralogical/paleontological, hydrological, recreational, and/or educational or scientific values according to the Federal Cave Resources Protection Act (FCRPA).
- The cave and karst system along the west slope of the Big Horn Mountains, including the Medicine Lodge, Spanish Point, and Little Mountain areas, is important due to fragile mineral deposits or specimens (speleothems), the potential for diverse cave and karst aquatic organisms and biological communities, cultural resources, recreational opportunities, and its link to regional groundwater aquifers.
- Sediments, and mineral deposits, including speleothems, in caves are a source of paleoclimate and other scientific information, providing important opportunities for education and scientific research. Due to their sensitive and nonrenewable nature, excessive recreational use, or recreational use not consistent with cave and karst resource values, can potentially, irreparably impact these systems. Adverse impacts to cave and karst resources also would impact the biological communities that depend on them.
- The potentially hazardous, often unfamiliar nature of caves can put inexperienced recreationists at risk.
- Recreational use of caves would be managed under a cave management plan to promote the importance of cave resources, to protect and maintain cave resources and the habitat in and around them, and to enhance user experiences by managing use compatibly with resource protection.

4.1.5.2 Summary of Impacts by Alternative

Adverse impacts to cave and karst areas would result from management that increases incompatible or excessive recreational use. The principle beneficial impacts to cave and karst resources, regardless of the alternative, result from managing the recreational use of caves to protect and maintain cave resources, while enhancing user experiences through ensuring compatible use levels and promoting the importance and research of cave resources. Under Alternative A, management of cave and karst resources as the Worland Cave SRMA would preserve the recreational setting in caves and provide protection of these resources by promoting appropriate recreational uses. Alternative B manages cave and karst resources as a separate Caves and Karst Extensive Recreation Management Area (ERMA), which would result in similar impacts to those under Alternative A, but to a lesser degree. Management of cave and karst resources under the general Bighorn Basin ERMA with no additional special protections for these areas in alternatives C and D would result in the fewest beneficial impacts. Protection for these areas through the designation of ACECs would be greatest under Alternative B, followed by alternatives A, D, and C, respectively. Alternative B would be the most beneficial for scientific research and data collection in cave and karst areas.

4.1.5.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Numerous beneficial direct impacts to cave and karst resources may result from proactive management actions under all alternatives. Implementing BMPs to protect water quality within cave and karst areas exhibiting unique underground drainage characteristics would preserve the hydrological and biological characteristics in these areas.

Managing cave and karst resources as ROW avoidance/mitigation areas and limiting motorized vehicle use to designated roads and trails in areas over important caves or cave passages would result in beneficial impacts by reducing potential destruction and minimizing surface disturbance and the potential for excessive or incompatible recreational uses in these areas. Managing the recreational use of caves under a specific management plan would result in beneficial impacts by promoting the significance and importance of cave resources through education; protecting and maintaining cave resources, including wildlife and habitat in and around caves; and enhancing user experiences by managing use levels to be compatible with resource carrying capacity and protection.

Designating the Spanish Point Karst ACEC under all of the alternatives would restrict resource uses and activities that may adversely affect cave and karst resources in this area.

Indirect beneficial impacts would result from management actions under all alternatives that maintain or improve the hydrological, biological, and chemical characteristics of water in cave and karst resources. Under all alternatives, these management actions include controlling water runoff from disturbed or developed sites; implementing local watershed management plans and/or TMDLs with interested stakeholders and the Wyoming DEQ; cooperating with stakeholders to plug unneeded abandoned water wells to prevent groundwater contamination; and cooperating with the EPA, the state of Wyoming, and local governments to develop source water wellhead protection plans (groundwater aquifers can be linked to cave and karst systems, as in the Medicine Lodge area).

Accomplishing cave resource protection and providing for user safety with controls such as timing of use to avoid crowding and closing caves to use during periods of high water runoff would result in beneficial impacts to caves. These actions would provide for the protection of- or reduce the potential degradation of cave resources.

Alternative A

Allowing commercial recreational use of Spirit Mountain cave on a case-by-case basis may result in short-term adverse impacts to this cave resource by increasing human activity and the potential for degradation of geologic or biological features in the cave.

Allowing scientific research of cave and karst areas on a case-by-case basis may result in beneficial impacts by increasing the understanding of cave and karst areas and their associated geological, biological, cultural, paleontological, hydrological, and educational values. An increased understanding of cave and karst characteristics and values may lead to improved management or may lead to the identification of specific values that require additional management to protect the resource.

Managing cave and karst resources as the Worland Cave SRMA, with goals of providing protection for cave resources and informing the public on proper recreational uses, would result in beneficial impacts to recreational opportunities and settings in this area. However, recreational use may result in adverse impacts to cave and karst resources by increasing the potential for damage and degradation.

Designating the Sheep Mountain Anticline and Little Mountain ACECs under Alternative A would result in beneficial impacts to cave and karst resources by placing additional restrictions on activities and resource uses (e.g., minerals development and motorized vehicle use) that may degrade these resources.

Alternative B

Allowing commercial recreational use of Spirit Mountain cave on a case-by-case basis would result in the same impacts as those described under Alternative A.

Scientific research of cave and karst areas would result in similar impacts as those described under Alternative A, though to a greater degree due to management to actively pursue research opportunities. Beneficial impacts to cave and karst resources from scientific research under Alternative B would be greater than the other alternatives.

Managing cave and karst resources under a specific ERMA would result in long-term impacts to these resources. Management as an ERMA would provide custodial oversight of recreational activities in these areas to provide for resource protection and to resolve use and user conflicts, which would result in beneficial impacts to cave and karst resources.

Designating the Sheep Mountain Anticline and Little Mountain ACECs under Alternative B, would result in similar beneficial impacts to cave and karst resources in these ACECs as described under Alternative A, though to a greater degree with more restrictions placed on resource uses and activities that may adversely affect cave and karst resources. The Little Mountain ACEC expansion area may also include more known and yet-to-be discovered cave and karst resources in the ACEC area.

Alternative C

Management of Spirit Mountain Cave would result in similar impacts as those described under Alternative A, but to a greater degree. Encouraging commercial caving tours may increase the number of visitors and the potential degradation of geologic and biological features in caves resulting in greater adverse impacts to this area compared to alternatives A, B, and D.

Allowing scientific research in caves would result in the same beneficial impacts as those described under Alternative A.

Managing cave and karst resources under the general Bighorn Basin ERMA would not provide for the beneficial impacts that would result from designation of cave and karst areas as a separate recreation management area.

The BLM does not designate the Sheep Mountain Anticline and Little Mountain ACECs under Alternative C; therefore, no beneficial impacts would result in these areas by restricting activities and resource uses that may degrade cave and karst resources.

Alternative D

Alternative D allows commercial caving tours of Spirit Mountain Cave, which may increase recreational use of the cave and the potential for adverse impacts more than alternatives A and B. However, impacts would be less than under Alternative C, as Alternative D would allow, but not encourage, commercial caving tours.

Allowing scientific research in caves would result in the same beneficial impacts as those described under Alternative A.

As under Alternative C, management of cave and karst resources under the general Bighorn Basin ERMA would provide less of a beneficial impact to cave and karst resources than alternatives A and B, which manage cave and karst resources as a separate recreation management area.

Alternative D places additional restrictions on activities and resource uses that could degrade cave and karst resource within the Sheep Mountain Anticline and Little Mountain ACECs, resulting in similar beneficial impacts as Alternative A.

4.2 Mineral Resources

4.2.1 Locatable Minerals

Implementation of the alternatives would result in some public lands being opened, segregated, or withdrawn from locatable mineral entry under the mining laws. Such actions could affect the ability of potential mining claimants and/or exploration and mining companies to explore and develop locatable minerals on some public lands in the Planning Area. Management actions that restrict access include short-term actions, such as 2-year land segregations, or long-term actions, such as seeking and obtaining 20-year withdrawals from the operation of the mining laws, subject to valid existing rights. In these instances, only valid, existing mining claims may be developed. Subject to such valid existing rights, exploration, staking of new mining claims, development, or mining on segregated or withdrawn federal mineral estate is prohibited. Mining claimants or operators must submit a plan of operations if they propose operations that would exceed casual use on withdrawn lands, regardless of the acreage proposed for surface disturbance. The BLM must first determine the validity of preexisting mining claims in withdrawals before approving plans of operation.

Mining claimants or operators also must file a plan of operations before beginning operations that exceed casual use in areas in the NWSRS and areas designated for potential addition to the system; designated ACECs; designated wilderness areas; areas closed to motorized vehicle use; any lands or waters known to contain federally proposed or listed threatened or endangered species or their proposed or designated important habitat, unless the BLM allows for other action under a land use plan or threatened or endangered species recovery plan; and BLM-administered National Monuments and National Conservation Areas. Based on this regulatory framework, management actions that result in lands being placed or removed from any of these land-status categories either will restrict or will remove limitations on access in cases where proposed exploration for locatable minerals would otherwise be performed under a notice, without the need for prior approval from the BLM (43 CFR 3809.11 and 43 CFR 3809.21).

Adverse impacts to locatable minerals include management actions that segregate, withdraw, or limit the development of locatable minerals. Beneficial impacts to locatable minerals result from management actions that open access to federal locatable minerals, including allowing withdrawals or segregations to expire without seeking new withdrawals. Direct impacts to locatable mineral operations result from management actions or statutory or regulatory limitations that open or restrict the exploration for or development of these minerals. Examples of direct impacts include segregations or withdrawals from locatable mineral entry, or compliance with the Endangered Species Act (ESA) to prevent adverse impacts to threatened or endangered species or their habitat. No indirect impacts to locatable minerals are identified.

4.2.1.1 Methods and Assumptions

This analysis is based on occurrence potential (referred to as “potential” in this analysis) for minerals identified in the *Solid Mineral Occurrence and Development Potential Report, Bighorn Basin Resource Management Plan Revision Project* (BLM 2009c). “Potential” refers to the potential for or the presence (occurrence) of a concentration of one or more locatable mineral resources. It does not refer to or imply potential for development and/or extraction of the mineral resource(s). It does not imply that the potential concentration is or may be economic (i.e., could be extracted profitably). The mineral potential classification system is based on the level of potential and the level of certainty of data supporting the possible existence of minerals. The system classifies level of potential as No (O), Low (L),

Moderate (M), High (H), and Not Determined (ND). The system classifies level of certainty as A (lowest certainty), B, C, and D (highest certainty). See the *Solid Mineral Occurrence and Development Potential Report, Bighorn Basin Resource Management Plan Revision Project* (BLM 2009c) or BLM Manual 303I, *Energy and Mineral Resource Assessment* for more information on the mineral potential classification system.

Methods and assumptions used in this impact analysis include the following:

- Restrictions on resource uses apply throughout the life of the RMP, but can be changed by amending the RMP.
- The surface management regulations at 43 CFR 3809 (outside WSAs) and 3802 (within WSAs) apply to all surface-disturbing activities for locatable minerals.
- Lands not formally withdrawn or segregated from mineral entry will be available for locatable mineral entry, exploration, and development as per the regulations at 43 CFR 3800 and 3810.
- The BLM must approve a plan of operations that meets all applicable statutory and regulatory requirements and will not cause unnecessary or undue degradation as per 43 CFR 3809 and 3802.
- Regardless of the level of operations to be conducted (casual use, notice level, or operations under a plan of operations), a locatable mineral operator must prevent adverse impacts to threatened or endangered species and their habitat that may be affected by operations.
- Locatable mineral operators may not knowingly disturb, alter, injure, or destroy any scientifically important paleontological remains or any historical or archeological site, structure, building, or object on federal lands.
- Notice level operations do not require approval from the BLM (i.e., there is no “federal action”) but are bound by statutory requirements, including the ESA, the National Historic Preservation Act (NHPA), and the requirement under the Federal Land Policy and Management Act (FLPMA) to prevent unnecessary or undue degradation of public lands.
- The potential for mineral resources is a prediction of the likelihood of the occurrence of these resources. The occurrence of a mineral resource does not necessarily imply that the mineral can be economically exploited or is likely to be developed; mineral occurrence potential includes both exploitable and potentially exploitable occurrences. The potential for the occurrence of a mineral resource also does not imply that the quality and quantity of the resource are known.
- On lands which are open to operations under the mining law, as amended, operators may conduct casual use operations, explore, locate new mining claims, submit notices under 43 CFR 3809, or seek approval of plans of operations under 43 CFR 3802 or 43 CFR 3809. This is the case even in areas which are currently believed to have low or no potential for the occurrence or development of locatable minerals.
- Known (H/D) bentonite-bearing strata within the Planning Area (Map 4) are primarily located in the eastern half of the Planning Area, but are also found in the southern and western portions of the Planning Area near Thermopolis and Cody. Refer to the *Solid Mineral Occurrence* and *Development Potential Report,* (BLM 2009c) for detailed maps of other locatable mineral potential within the Planning Area.
- Commercially important bentonite deposits in the Planning Area are found only in the Thermopolis, Mowry, and Frontier Formations. Wherever these formations crop out, the potential for bentonite occurrence is high, though not always in commercial quantities, with a certainty level of D (H/D). There is a moderate (M) potential for bentonite in portions of the

lowermost Cretaceous Cody Shale, with a certainty level of D (M/D). Bentonitic clay beds occur in the Morrison, Meeteetse, and Fort Union formations, and in the Aycross and Tepee Trail formations, however these beds are not generally considered of commercial quality or significance. In the balance of the Planning Area, the potential for bentonite is low (L) with a certainty level of D (L/D).

- About 346,181 acres of federal mineral estate have a known high-to-moderate potential for the occurrence of bentonite, and about 3,861,368 acres have low potential. The potential for bentonite development activity, particularly in the eastern half and southern portions of the Planning Area, is high. Bentonite will continue to be mined using surface mining methods.
- Gypsum-bearing strata within the Planning Area (Map 5) occur generally in the eastern portion of the Planning Area. Gypsum beds occur in commercial amounts only in the Jurassic Gypsum Spring Formation. Wherever this formation crops out, the potential for gypsum is high with a certainty level of D (H/D), though not always in commercial quantities. In areas where the Goose Egg Formation occurs, potential for gypsum is determined to be moderate (M) with a certainty level of C (M/C). In the balance of the Planning Area, potential gypsum is rated as low (L) with a certainty level of D (L/D).
- About 115,747 acres of federal mineral estate have a known high-to-moderate potential for the occurrence of gypsum, and about 4,091,802 acres have low potential. The potential for continued gypsum mining activity, particularly in several locations in the CYFO, is high. Gypsum will continue to be mined using open pit/surface mining methods.
- Potential uranium-bearing strata within the Planning Area are located in the extreme northeast part of the Planning Area (Little Mountain Uranium District). The potential for the occurrence of uranium mineralization in the Little Mountain District, a known uranium producing area, is rated as high (H) with a certainty level of D (H/D). Potential for low level (noncommercial grade) uranium mineralization in the Eocene Aycross and Tepee Trail formations is determined to be moderate (M) with a certainty level of B (M/B). The potential for uranium throughout the remainder of the Planning Area is rated as low (L) with a certainty level of C (L/C).
- Potential thorium-bearing strata within the Planning Area are located in small deposits in various locations throughout the Planning Area. Potential for the occurrence of thorium mineralization coincident with titaniferous black sandstone deposits in the Planning Area is rated as high (H) with a certainty level of D (H/D). The potential for thorium mineralization elsewhere in the Mesaverde Formation is rated as moderate (M) with a certainty level of B (M/B). The potential for thorium throughout the remainder of the Planning Area is rated as low (L) with a certainty level of C (L/C). Currently, there is no active exploration for or mining of thorium taking place in the Planning Area. This is not expected to change over the life of the plan.
- About 130,052 acres of federal mineral estate have a known high-to-moderate potential for the occurrence of uranium, with 4,077,497 acres with low potential. There are about 213,678 acres of federal minerals with a known high-to-moderate potential for the occurrence of thorium, and about 3,995,405 acres with low potential. Currently, there is no active exploration for or mining of uranium or thorium taking place in the Planning Area. Interest in uranium exploration could increase during the planning period with a rise in uranium prices. The lack of exploration for or mining of thorium is not expected to change over the life of the plan.
- The southwest-central and northwest portions of the Planning Area contain very limited quantities of placer gold. The potential for low-grade placer gold (in non-commercial quantities

only) in specific areas of the Planning Area is rated as moderate (M) with a certainty level of C (M/C). In the balance of the Planning Area, potential is low (L) with a certainty level of B (L/B).

- About 51,285 acres of federal mineral estate have a known (high) potential for the occurrence of placer gold. The potential for placer gold development activity is low for the planning period.
- Titaniferous black sandstone paleoplacer deposits occur in specific locations in the southern, eastern, and northern portions of the Bighorn Basin, but are not currently being developed in the Planning Area. In areas of known titaniferous black sandstone deposits, the potential for titanium and zirconium is rated as high (H) with a certainty level of D (H/D). Potential for titaniferous sandstones in the other areas such as Absaroka foothills region is rated as low (L) with a certainty level of C (L/C). The potential for titaniferous sandstones in the balance of the Planning Area is rated as low (L) with a certainty level of C (L/C).
- About 213,678 acres of federal mineral estate have a known high-to-moderate potential for the occurrence of titaniferous black sands. The potential for the development of titaniferous black sands over the planning cycle is estimated to be low, though some small-scale mining of black sand is possible.
- The potential for the occurrence of all metallic minerals other than placer gold and titanium-bearing black sands is determined to be low (L) with a certainty level of C (L/C) in the Planning Area. The proper geologic conditions, namely, igneous plutons and/or metamorphosed ore bodies, do not exist in the Planning Area.
- The potential for the development of these metallic minerals is considered low during the planning period.
- Although discoveries of other valuable deposits of locatable minerals may occur during the planning period, bentonite and gypsum will remain the dominant locatable minerals being mined in the Planning Area. See the *Solid Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information on the occurrence and development potential for locatable minerals within the Planning Area.

4.2.1.2 Summary of Impacts by Alternative

Implementation of the alternatives would result in public lands being opened (a beneficial impact), or withdrawn or segregated (an adverse impact) from appropriation under the mining laws. Alternative B, primarily due to withdrawals for ACECs and WSR suitable waterway segments, would result in the largest acreage of restrictions to locatable mineral (325,102 acres), followed by Alternative A (174,354 acres), then Alternative D (72,031 acres), and Alternative C (47,846 acres). Alternative B includes the greatest acreage of withdrawals in known or moderate potential areas for occurrence of common locatable minerals, followed by alternatives A, D, and C respectively.

4.2.1.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Subject to valid existing rights, restrictions on exploration and development of locatable minerals would result in adverse impacts when areas are withdrawn, segregated, or classified from locatable mineral entry, or with the application of other resource restrictions that limit or prohibit mineral activity. The intensity of impacts varies by alternative and whether there are existing locatable minerals activities in an area proposed for withdrawal or segregation. The more acreage withdrawn, segregated, or classified, the more adverse impacts to exploration and development of locatable mineral resources

occur. Withdrawals would result in more impacts where withdrawals apply to locatable mineral areas with known or moderate potential. Discussions of individual alternatives describe adverse impacts to exploration and development of locatable minerals from these actions. See Table 3-40 in Chapter 3, Existing and Proposed Withdrawals, Classifications, and Other Segregations in the Planning Area, for additional information about existing withdrawals and segregations and the associated resources that those actions are intended to protect. Under all alternatives, the BLM anticipates that mining for locatable minerals would likely occur using surface mining methods.

Management actions in the lands and realty program that revoke or require the review of existing withdrawals that segregate areas from locatable mineral entry would result in beneficial impacts to locatable mineral exploration and development by opening new areas to operation under the mining laws. These revocations and reviews include opening restored BOR lands, revoking 3,287 acres of Classification and Multiple Use (C&MU) lands, and reviewing 14,341 acres of power withdrawals/classifications and 14,381 acres of other agencies' withdrawals. Continuing existing classifications and segregations would withdraw these areas from operation under the mining laws, which would result in adverse impacts.

Pursuing newly proposed BLM protective withdrawals and other agency withdrawal requests on a case-by-case basis would result in adverse impacts to locatable mineral exploration and development if areas are withdrawn from mineral entry.

It is important to note that because of overlapping management restrictions, withdrawals associated with resource and resource uses described in this section are not additive. A list of all withdrawals from locatable mineral entry and associated acreages by alternative are supplied in Table 4-13 in Section 4.6.1 *Lands and Realty*.

Alternative A

Under Alternative A, the BLM maintains withdrawals for locatable minerals on 174,354 acres, or approximately 4 percent, of the federal mineral estate in the Planning Area.

Under Alternative A, the following locatable minerals and associated acreages (and percent of total occurrence on federal mineral estate in the Planning Area) are known to occur or have a moderate potential for occurrence in areas pursued for withdrawal from operation of the mining laws, as amended:

- Bentonite – 25,079 acres (7 percent) of known occurrence
- Gypsum – 9,268 acres (13 percent) of known occurrence and 4,209 acres (9 percent) of moderate potential
- Uranium – 16,605 acres (90 percent) of known occurrence and 7,389 acres (7 percent) of moderate potential
- Thorium – 4,940 acres (2 percent) of moderate potential
- Titaniferous black sands – 4,940 acres (2 percent) of moderate potential

The remainder of the discussion for this alternative identifies the major withdrawals that result from other resources and uses, regardless of known mineral occurrence or mineral potential.

Resource Uses

Specific lands and realty actions, establishing some recreation sites, and management of special designations, may result in adverse impacts to exploration for or development of locatable mineral resources. Adverse impacts may result when management actions related to these uses and

designations result in either a withdrawal or a segregation of the federal mineral estate from locatable mineral entry, which closes the lands to entry under the mining laws, as amended. Conversely, lifting withdrawals, segregations, or some existing mineral classifications could open the lands to locatable mineral entry.

Under Alternative A, termination of all existing coal and phosphate withdrawals or classifications would open lands previously withdrawn from locatable mineral entry, which would result in beneficial impacts to new locatable mineral activities. Lands and realty actions under Alternative A include approximately 644 acres of land classifications under the Recreation and Public Purposes (R&PP) Act, which have the effect of segregating the classified lands from locatable mineral entry (location of new mining claims) under the mining laws, as amended.

In addition, C&MU classifications (Little Mountain Area) and Desert Land Entries (DLEs) segregate an additional 4,696 acres from locatable mineral entry. Other segregations under Alternative A include public water reserves (2,763 acres) and power-site reservations (3,468 acres). Withdrawals from locatable mineral entry for other federal agencies, including the Federal Energy Regulatory Commission (FERC), the U.S. Department of Defense, the National Park Service, the BOR, and the USFS, total approximately 121,052 acres. See Section 4.6.1 *Lands and Realty* for more detailed discussion of classifications, segregations, and withdrawals.

Under Alternative A, the Beck Lake Scenic Area (708 acres) and the Castle Gardens Recreation Site (110 acres) are withdrawn from appropriation under the mining laws for the protection of recreation resources in these areas.

Special Designations

Under Alternative A, the BLM withdraws several WSR eligible waterway segments and ACECs from locatable mineral entry, including the Big Cedar Ridge, Red Gulch Dinosaur, Sheep Mountain Anticline, Spanish Point Karst, Five Springs Falls, and Upper Owl Creek ACECs. In addition, all designated ACECs (71,297 acres, including the withdrawn ACECs) and all areas closed to motorized vehicle use (59,192 acres) require a plan of operation before mining can begin for all activity exceeding casual use; such a requirement may either restrict or remove limitations on access to these areas for exploration for locatable minerals and may result in adverse impacts in the form of delay for claimants, who would otherwise be able to undertake these activities without prior approval from the BLM. Under all alternatives, the Heart Mountain Relocation Center National Historic Landmark (72 acres) would be withdrawn from appropriation under the mining laws.

Resources

Under Alternative A, cave and karst areas are withdrawn from locatable mineral entry to prevent degradation of these resources. The BLM also withdraws certain areas in the Big Cedar Ridge and Red Gulch Dinosaur Tracksite ACECs (2,062 acres) to protect paleontological resources. The BLM withdraws important cultural sites from appropriation under the mining laws on a case-by-case basis.

Alternative B

Alternative B would pursue withdrawal from appropriation under the mining laws for locatable minerals on 325,102 acres, or 8 percent, of the federal mineral estate in the Planning Area. These withdrawals are greater than under any other alternative.

Under Alternative B, the following locatable minerals and associated acreages (and percent of total occurrence on federal mineral estate in the Planning Area) are known to occur or have a moderate

potential for occurrence in areas pursued for withdrawal from operation of the mining laws, as amended:

- Bentonite – 25,703 acres (7 percent) of known occurrence
- Gypsum – 12,650 acres (18 percent) of known occurrence and 7,358 acres (16 percent) of moderate potential
- Uranium – 16,605 acres (90 percent) of known occurrence and 11,764 acres (11 percent) of moderate potential
- Thorium – 3,702 acres (2 percent) of moderate potential
- Titaniferous black sands – 3,702 acres (2 percent) of moderate potential

The remainder of the discussion for this alternative identifies the major withdrawals that would result from other resources and uses, regardless of known mineral occurrence or mineral potential.

Resource Uses

Under Alternative B, all existing coal and phosphate withdrawals and classifications would continue. These withdrawals and classifications would not result in adverse impacts to exploration and development of locatable minerals, because there is generally no known interest in exploration for or development of locatable minerals in the areas where there are coal or phosphate classifications.

Lands and realty management actions under this alternative are expected to result in similar impacts to locatable minerals access as under Alternative A, but to a slightly greater extent. Lands and realty actions under Alternative B include a withdrawal for a 208-acre industrial park in Cody, Wyoming. Other segregations and withdrawals under Alternative B would result in impacts similar to those actions described for Alternative A, except for a decrease in other federal agency withdrawals. A complete list of the withdrawals, classifications, and other segregations in the Planning Area by alternative is provided in Table 4-13 in Section 4.6.1 *Lands and Realty*.

Management actions that withdraw recreational areas under Alternative B are expected to result in impacts to locatable minerals access similar to those actions under Alternative A.

Special Designations

Special designations under Alternative B that would result in withdrawal of some lands from locatable mineral entry include all WSR suitable waterway segments and all ACECs except the Little Mountain and Upper Owl Creek/Absaroka Front proposed expansion areas. Compared to other alternatives, this would result in the most withdrawal acreages due to special designations.

In addition, Alternative B includes the largest area of designated ACECs (299,954 acres, including the withdrawn ACECs) and areas closed to motorized vehicle use (136,474 acres). Therefore, this alternative would result in more adverse impacts to claimants from requirements for plans of operation.

Resources

Withdrawals from locatable mineral entry for resource protection under Alternative B are anticipated to be similar to Alternative A, except that Alternative B withdraws more area for the protection of paleontological resources in ACECs. Other management actions under Alternative B to protect resources are expected to be similar to those under Alternative A.

Alternative C

Under Alternative C, withdrawals would be pursued on 47,846 acres, or 1 percent, of the federal mineral estate in the Planning Area, a smaller amount than the other alternatives.

Under Alternative C, the following locatable minerals and associated acreages (and percent of total occurrence on federal mineral estate in the Planning Area) are known to occur or have a moderate potential for occurrence in areas pursued for withdrawal from operation of the mining laws, as amended:

- Bentonite – 19,423 acres (6 percent) of known occurrence
- Gypsum – 4,777 acres (7 percent) of known occurrence and 3,537 acres (8 percent) of moderate potential
- Uranium – 5,622 acres (31 percent) of known occurrence and 2,199 acres (2 percent) of moderate potential
- Thorium – 3,614 acres (2 percent) of moderate potential
- Titaniferous black sands – 3,614 acres (2 percent) of moderate potential

The remainder of the discussion for this alternative identifies the major withdrawals that would result from other resources and uses, regardless of known mineral occurrence or mineral potential.

Resource Uses

Under Alternative C, the BLM would terminate all coal and phosphate withdrawals and classifications, resulting in the same impacts to locatable mineral entry as under Alternative A. Other segregations and withdrawals under Alternative D would results in impacts similar to those actions under Alternative A, except there would be less area withdrawn for other agencies and public water reserves, which would benefit locatable mineral development. A complete list of the withdrawals, classifications, and other segregations in the Planning Area by alternative is provided in Table 4-13 in Section 4.6.1 *Lands and Realty*.

Under Alternative C, the Castle Gardens Recreation Site (110 acres) is withdrawn for protection of recreational use, but in contrast to the other alternatives, does not withdraw the Beck Lake Scenic Area from locatable mineral entry.

Special Designations

Under Alternative C, federal mineral estate under the Spanish Point Karst ACEC is the only special designation with a withdrawal from locatable mineral entry, resulting in the smallest adverse impact to locatable mineral entry.

Alternative C includes the smallest area designated as ACECs (12,144 acres) and closed to motorized vehicle use (10,636 acres), and would therefore result in the fewest adverse impacts to claimants from requirements for plans of operation.

Resources

The BLM expects withdrawals from locatable mineral entry for resource protection under Alternative C to be similar to Alternative A, except that the BLM would not withdraw any areas for the protection of paleontological resources.

Alternative D

Under Alternative D, withdrawals would be pursued on 72,031 acres, or 2 percent, of the federal mineral estate in the Planning Area, a larger area than under Alternative C, but smaller than under alternatives A and B.

Under Alternative D, the following locatable minerals and associated acreages (and percent of total occurrence on federal mineral estate in the Planning Area) are known to occur or have a moderate potential for occurrence in areas pursued for withdrawal from operation of the mining laws, as amended:

- Bentonite – 21,628 acres (6 percent) of known occurrence
- Gypsum – 9,088 acres (13 percent) of known occurrence and 3,603 acres (8 percent) of moderate potential
- Uranium – 6,007 acres (33 percent) of known occurrence and 2,658 acres (2 percent) of moderate potential
- Thorium – 3,655 acres (2 percent) of moderate potential
- Titaniferous black sands – 3,655 acres (2 percent) of moderate potential

The remainder of the discussion under this alternative identifies the major withdrawals that result from other resources and uses, regardless of known mineral occurrence or mineral potential.

Resource Uses

Under Alternative D, all existing coal and phosphate withdrawals and classifications would continue unless they are no longer needed. Similar to Alternative B, this would not result in adverse impacts to exploration and development of locatable minerals, because there is generally no known interest in exploration for or development of locatable minerals in the areas where coal or phosphate classifications exist.

Similar to Alternative B, lands and realty actions under Alternative D do not open a 209 -acre industrial park in Cody, Wyoming, to locatable mineral entry. Other segregations and withdrawals under Alternative D would result in impacts similar to those actions under Alternative A, except for a small decrease in land withdrawn for power-site reservations and a larger decrease in other federal agency withdrawals. A complete list of the withdrawals, classifications, and other segregations in the Planning Area by alternative is provided in Table 4-13 in Section 4.6.1 *Lands and Realty*.

Management actions that withdraw certain areas for the protection of recreational resources under Alternative D are expected to result in impacts to locatable minerals access similar to those actions under Alternative A.

Special Designations

Under Alternative D, withdrawals are pursued on the second-fewest acres of ACECs, after Alternative C, but the alternative includes the most acreage that can be withdrawn in ACECs on a case-by-case basis for resource protection. In contrast to alternatives A and B, Alternative D does not include special management that would withdraw WSR eligible waterway segments. However, Alternative D would withdraw a portion of the Chapman Bench Management Area (3,425 acres) for resource protection. Alternative D includes the second-most acreage designated as ACECs (103,128 acres, including the withdrawn ACECs) and the third-largest area closed to motorized vehicle use (60,681 acres), which would result in adverse impacts to claimants from requirements for plans of operation.

Resources

Under Alternative D, withdrawals from locatable mineral entry for resource protection of cave and karst and paleontological resources would be similar to those under Alternative B, except that the BLM would withdraw less area for the protection of paleontological resources.

4.2.2 Leasable Minerals – Coal

The BLM does not anticipate reasonable foreseeable coal exploration, leasing, or development during the planning cycle. If the BLM receives an application for a federal coal lease, an appropriate land use and environmental analysis, including the coal screening process, would be necessary to determine whether the area(s) proposed for leasing are acceptable for coal development and leasing (in accordance with 43 CFR 3425). If the BLM determined that public lands were acceptable for further consideration for coal leasing, the land use plan would need to be amended, as necessary. The BLM would accept federal coal lease applications only for federal coal lands with development potential identified as suitable for further leasing consideration, after application of the coal screens and unsuitability criteria.

4.2.2.1 Analysis of Alternatives

If interest arises, the BLM may allow coal exploration subject to the regulations at 43 CFR 3410 and subject to Appendix H guidance to mitigate surface-disturbing activities. Closing large areas to mineral leasing or applying NSO restrictions on large areas may adversely affect potential coal leasing in the Planning Area if demand were to arise. Major and moderate constraints on mineral leasing, geophysical exploration, and minerals development also would adversely impact potential future coal leasing.

4.2.3 Leasable Minerals – Oil Shale

The BLM anticipates the potential for oil shale exploration and development activity would be low for the next planning cycle because of the relative thinness of oil shale beds, thickness of overburden, and poor quality of oil shale in the Planning Area. In 2008, the BLM released a *Programmatic Environmental Impact Statement (EIS) for Oil Shale and Tar Sands* (BLM 2009f) that amended existing RMPs in Wyoming and other states. The only areas of Wyoming addressed in this Programmatic EIS were the Washakie and Green River Basins in the southwestern part of the state. The Programmatic EIS did not include the Bighorn Basin because oil shale resources in the Bighorn Basin are not considered economically feasible to produce. Oil shale exploration, development, and leasing in the Planning Area would require additional evaluation and an RMP amendment.

4.2.3.1 Analysis of Alternatives

The BLM did not consider oil shale leasing and development under any alternative due to the absence of known, commercially exploitable resources and lack of anticipated leasing and development. The BLM does not anticipate impacts to oil shale leasing and development. However, closing large areas to mineral leasing or applying NSO restrictions on large areas may adversely affect potential oil shale leasing in the Planning Area if demand were to arise. Major and moderate constraints on mineral leasing, geophysical exploration, and minerals development also may adversely impact potential oil shale leasing.

4.2.4 Leasable Minerals – Geothermal

Lands in the Planning Area have been classified as having low to negligible potential for geothermal development, with the exception of lands surrounding the known hydrothermal spring areas near Thermopolis and Cody (BLM 2009j). Due to current policy direction guiding the development of renewable energy resources on public lands, there could be increased interest in geothermal exploration and development in the Planning Area over the next 10 to 20 years. The *Reasonable Foreseeable Development Scenario for Geothermal, Bighorn Basin Planning Area* (BLM 2009j) provides more information and related studies on geothermal resources and development potential in the Planning Area.

The definition of direct/indirect, beneficial/adverse, and short-term/long-term impacts described in Section 4.2.5 *Leasable Minerals - Oil and Gas* would be the same for geothermal exploration and development. In addition, adverse impacts to geothermal resources result from management that may limit or prohibit public use of geothermal resources (hot springs). Beneficial impacts would result from management that maintains or increases public use and access to geothermal resources.

Managing geothermal leasing on split-estate lands (federal mineral ownership and private surface ownership) would not limit or prohibit the use of warm water or normal-temperature geothermal systems for nonutility-grade home heating or other applications.

4.2.4.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Except as noted for alternatives B and D, where differences occur in leasing availability, BLM-administered land in the Planning Area that is open to oil and gas leasing will be open to geothermal leasing, subject to appropriate mitigation developed through use of the mitigation guidelines described in Appendix H.
- Unless otherwise noted, those lands identified as administratively unavailable for oil and gas leasing will be administratively unavailable for geothermal leasing.
- There will be low to moderate potential interest in development of geothermal resources during the planning period.
- Any potential geothermal development on federal mineral estate in the Planning Area would be carefully assessed to avoid adverse impacts to geothermal resources developed near Thermopolis and Cody, Wyoming.

4.2.4.2 Summary of Impacts by Alternative

The principle source of adverse impacts to geothermal exploration and development result from applying restrictions (i.e., managing these areas as administratively unavailable or applying NSO or CSU stipulations) on areas with development potential; managing these areas as open to geothermal leasing with standard restrictions would generally result in beneficial impacts. Geothermal resources in the Planning Area are classified as moderately low to negligible and, since none of these resources are capable of generating electricity, restrictions on geothermal exploration and development are anticipated to result in minimal impacts under all alternatives. Alternative B would result in the greatest potential for adverse impacts to geothermal exploration and development as it contains the largest area administratively unavailable to geothermal leasing (2,493,630 acres), followed by Alternative D (324,737 acres), Alternative A (154,861 acres), and Alternative C (147,760 acres). Alternatives B and D place additional restrictions on the geothermal development around the Hot Springs State Park in

Thermopolis, the only area of moderately low geothermal resources in the Planning Area; though these restriction would prevent commercial development, these alternatives would provide the greatest protection to the current public uses of these thermal springs.

4.2.4.3 Detailed Analysis of Alternatives

Management and restrictions for geothermal resources are the same as those for oil and gas resources. Except as noted for alternatives B and D, where there are differences in leasing availability, areas open to oil and gas leasing are open to geothermal leasing and areas administratively unavailable to oil and gas leasing are administratively unavailable to geothermal leasing. In addition, exploration and development of geothermal resources are subject to the same restrictions on surface-disturbing activities applied to oil and gas exploration and development. As a result, impacts to geothermal exploration and development by alternative would be the same as those described in Section 4.2.5 *Leasable Minerals - Oil and Gas*. Because commercial geothermal development requires drilling and facilities comparable to those associated with oil and gas development, management that affects oil and gas is expected to similarly affect geothermal development.

Because of the lower level of anticipated geothermal development compared to oil and gas development, impacts to geothermal resources from management actions may be less severe than those associated with oil and gas development. However, the extent of impacts between alternatives, based on management actions in the alternatives, would be the same.

This section identifies areas that have specific management actions for geothermal resources separate from oil and gas management in the area. Except as noted for alternatives B and D, see Section 4.2.5 *Leasable Minerals - Oil and Gas* for a discussion of the acreages open, open with constraints, and administratively unavailable, and the associated impacts comparison between alternatives.

Impacts Common to All Alternatives

Impacts to geothermal resources common to all alternatives would be similar to impacts described in Section 4.2.5 *Leasable Minerals - Oil and Gas*.

Under all alternatives, any potential geothermal development on federal mineral estate in the Planning Area would be carefully assessed to avoid adverse impacts to geothermal resources near Cody and Thermopolis, Wyoming.

Alternative A

Areas open subject to standard lease stipulations, open with constraints, and administratively unavailable to geothermal exploration and development, and resulting impacts, are the same as those described in Section 4.2.5 *Leasable Minerals - Oil and Gas* for Alternative A. Approximately 154,861 acres are administratively unavailable to geothermal leasing under Alternative A, resulting in direct adverse impacts to potential development of geothermal resources on these lands.

Lands within 15 miles of the Hot Springs State Park at Thermopolis are open to geothermal leasing under Alternative A. There has been no recent expressed interest in such leasing for commercial purposes on the federal mineral estate. Development of geothermal resources in the area of Hot Springs State Park is not within BLM jurisdiction because the state of Wyoming owns and controls the park and all surface water and groundwater resources.

Alternative B

Under Alternative B, 2,493,630 acres are administratively unavailable to geothermal leasing, which would result in impacts similar to those described in Section 4.2.5 *Leasable Minerals - Oil and Gas* for Alternative B. However, under Alternative B, more acreage is closed to geothermal leasing than oil and gas leasing because federal mineral estate is closed to geothermal leasing within 15 miles of Hot Springs State Park.

Managing federal mineral estate within 15 miles of Hot Springs State Park as administratively unavailable to geothermal leasing would not result in long-term adverse impacts to leasing, because the BLM does not anticipate interest in commercial geothermal leasing in this area over the next planning cycle. However, if interest in geothermal grows, there would be long-term adverse impacts to leasing.

Prohibiting geothermal development on federal mineral estate within 15 miles of Hot Springs State Park would ensure development would not alter pressures and volumes within the hydrothermal system. This would be a beneficial impact.

Alternative C

Under Alternative C, lands open to leasing subject to standard lease stipulations, open with constraints, and administratively unavailable to geothermal exploration and development, and the resulting impacts, would be roughly the same as those described for Alternative A, and described in Section 4.2.5 *Leasable Minerals - Oil and Gas* for Alternative C. Compared to the other alternatives, Alternative C designates the least land as administratively unavailable to geothermal leasing (147,760 acres).

Managing lands within 15 miles of the Hot Springs State Park as open to geothermal leasing would result in the same impacts as those described for Alternative A.

Alternative D

Under Alternative D, 324,737 acres are administratively unavailable to geothermal leasing, which would result in impacts similar to those described in Section 4.2.5 *Leasable Minerals - Oil and Gas* for Alternative D. However, more acreage is administratively unavailable to geothermal leasing than oil and gas leasing under Alternative D because of the closure of federal mineral estate to geothermal leasing within 5 miles of Hot Springs State Park.

Managing lands within 5 miles of Hot Springs State Park as closed to geothermal leasing would result in impacts similar to those described for Alternative B, though to a lesser extent because less area would be affected if interest in geothermal development grows. Alternative D would also provide a beneficial impact by requiring geothermal resource monitoring and protection within 5 miles of Hot Springs State Park and within the Thermopolis Anticline.

4.2.5 Leasable Minerals – Oil and Gas

The potential for oil and gas occurrence in the Planning Area ranges from high to low, depending on location, as documented in the RFD. The RFD for oil and gas in the Planning Area analyzed the potential for anticipated drilling activity over the next 20 years. Lands in the Planning Area are classified as having moderate to no potential for development of oil and gas resources, depending on location and based on projected drilling densities (BLM 2009u). Drilling in existing fields accounts for a large proportion of the growth, with a lesser share attributed to additional new discoveries in both conventional and unconventional reservoirs. The RFD considers the potential for development of CBNG in the Planning Area, depending on location, to be low, very low, or nonexistent.

There could be adverse impacts to oil and gas exploration and development activities from management actions that restrict or constrain the potential for oil and gas leasing, development, and exploration. Constraints to oil and gas development include NSO, CSU restrictions, timing limitations (TLS), or the allocation of public land for management of other resource objectives that limit or prohibit oil and gas exploration and development (e.g., visual resource management [VRM] allocations). Additional adverse impacts to exploration and development of oil and gas resources can result from specific management actions that require mitigation, certain BMPs, or other lease stipulations to protect resources that may increase project costs and timeframes. Beneficial impacts related to oil and gas exploration and development can result from management actions that ease restrictions or open areas for oil and gas exploration and development, thereby increasing the potential for leasing, exploration, and development.

Management actions to protect other resource values may directly and indirectly impact new oil and gas leases, exploration, and development. A direct impact is one that either specifically prohibits or permits oil and gas leasing, exploration, or development. Direct impacts include managing areas as administratively unavailable for new oil and gas leasing. Indirect impacts result from management actions that may place or remove surface use restrictions or additional requirements on oil and gas exploration and development (e.g., BMPs or mitigation). These actions do not explicitly permit or prohibit oil and gas exploration and development activity, but may influence an operator's decision about whether to proceed. An example of an indirect impact would be a seasonal restriction on entering a greater sage-grouse Key Habitat Area for part of the year.

4.2.5.1 Methods and Assumptions

The unconstrained baseline RFD for oil and gas in the Planning Area is based on a set of reasonable geologic, engineering, and economic assumptions about resource occurrence only, and past and present activity, without management constraints on future activities. An unconstrained RFD provides a basis for comparing alternatives. Constrained oil and gas projections typically are lower than those in the unconstrained baseline RFD because of management constraints on oil and gas activities in the alternatives.

It is important to note that the RFD is not a decision, and it neither establishes nor implies a "cap" on development. Surface disturbance associated with well counts likely will be reduced in the future as the result of improvements in drilling- and well-completion technologies and techniques. Thus, the BLM uses any discussion of well counts in the RFD only to form the basis for an analysis of levels of impact. In addition, because the RFD is a snapshot in time, it cannot capture how future advances in technology may make it possible to exploit certain oil and gas plays in the future that are currently not economical or commercially exploitable.

Chapter 3 includes a summary of unconstrained baseline projections for oil and gas drilling activity in the Planning Area. Appendix T includes detailed projections of well counts by alternative, which vary by the degree of management constraints. See the RFD for oil and gas for more specific information on baseline oil and gas development and drilling potential in the Planning Area (BLM 2009e).

Table 4-5 summarizes projected new-well counts for the alternatives and the baseline unconstrained projection (only standard lease stipulations would be required) (BLM 2009u). The projected new-well counts and estimated surface disturbance associated with wells described in this section are for the period 2008 through 2027. Appendix T includes well projections by type of oil and gas well by alternative.

Table 4-5. Bighorn Basin Planning Area Projected New-Well Counts by Alternative

Alternative	Total Coalbed Natural Gas Wells	Total Conventional Oil and Gas Wells	Total Oil and Gas Wells	Percent of Total Wells on Federal Mineral Estate
Baseline Unconstrained Projection[1]	150	1,715	1,865	72.6
Alternative A	130	1,511	1,641	68.9
Alternative B	84	936	1,020	49.9
Alternative C	124	1,644	1,768	71.1
Alternative D	98	1,436	1,534	66.7

Source: BLM 2009u
[1]Only standard lease stipulations would be applied.

Methods and assumptions used in this impact analysis include the following:

- Unless otherwise noted, areas that are open to oil and gas leasing will be open to geophysical exploration subject to appropriate mitigation developed through use of the mitigation guidelines described in Appendix H.
- Unless otherwise noted, areas closed to oil and gas leasing will be closed to geophysical exploration.
- The BLM can authorize, subject to appropriate mitigation developed through use of the mitigation guidelines described in Appendix H, geophysical exploration activities in VRM Class I and II areas because the operations are short-term activities.
- The BLM does not guarantee access to mineral leases that it issues.
- Analysis considers the baseline total unconstrained oil and gas development potential taken from the RFD for oil and gas as summarized in Chapter 3 and applies the alternative constraints from the other resource programs as described in Chapter 2. The RMP will not modify existing leases; as old leases expire and new ones are issued, new leases would be subject to relevant stipulations. However, site-specific COA can be applied to applications for permit to drill (APDs) on existing leases to avoid adverse impacts to resource values by development per 43 CFR 3101.1-2.
- Reasonable mitigation measures could include modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation requirements. These modifications might occur only through site-specific post-lease actions (e.g., APDs and ROWs) that are supported by onsite conditions and/or project-specific NEPA analysis. Any exceptions, modifications, or waivers to lease stipulations will only be authorized in accordance with applicable regulatory guidelines. Surface-disturbing and other disruptive activities could occur at existing authorized facilities.
- Post-lease NSO COA will not be applied to the entire acreage of existing oil and gas leases, as development must be allowed consistent with lease rights and terms.
- Areas open for oil and gas leasing subject to major constraints have greater adverse impacts on oil and gas leasing, exploration, and development compared to acres subject to either moderate constraints or standard stipulations. All areas identified as open in this analysis are subject to at

least standard stipulations. In addition, some of these areas are subject to moderate and/or major constraints.

Alternative	Constraint Type (acres)		
	Moderate	Major	Administratively Unavailable or Closed
Alternative A	1,789,634	1,399,490	154,861
Alternative B	451,948	1,320,277	2,296,279
Alternative C	2,175,814	221,536	147,760
Alternative D	3,540,775	117,968	291,294

- Moderate constraints are any stipulations or COA which may restrict the timing or placement of oil and gas development, but would not otherwise restrict the overall development. Moderate constraints include all TLS, CSUs, areas where surface-disturbing activity is avoided, and VRM Class II areas.
- Major constraints are any stipulations or COA which may restrict the timing or placement of oil and gas developments and may result in an operator dropping the development proposal. Major constraints include NSOs, areas of overlapping TLS that last more than 6 months, areas closed to surface-disturbing activity, areas where surface-disturbing activity is prohibited, and VRM Class I areas. Leaseholders have the right to explore, develop, and produce mineral resources from any valid, existing lease, even if the area containing the lease was proposed to be closed to future leasing.
- Because of overlaps between management restrictions on oil and gas leasing (i.e., CSU, TLS, and NSO), individual restrictions associated with resources and special designations described in this section are not additive. As described in the *Glossary*, the BLM has factored these overlapping restrictions into the overall oil and gas constraints (major, moderate, open, administratively unavailable) for each alternative, where appropriate. For example, while a TLS restriction is generally considered a moderate constraint, overlapping TLS that restrict the use of an area for 6 months or more are considered a major constraint. In areas where overlapping management is the same and applies year-round (e.g., two overlapping NSOs), there is no additional or additive effect. Finally, where different types of restrictions overlap (e.g., an area managed as an NSO for cultural resources and administratively unavailable for wildlife values), the more restrictive management would apply. Maps 17, 18, 19, and 20 provide a visual representation of constraints by alternative.
- Surface use restrictions, including TLS, NSO stipulations, and CSU stipulations, as well as unavailable for leasing designations, cannot be retroactively applied to valid, existing oil and gas leases or to valid, existing use authorizations (e.g., APD). Post-lease actions/authorizations (e.g., APDs, road/pipeline ROWs), however, could be encumbered by TLS and CSU restrictions on a case-by-case basis, as required through project-specific NEPA analysis or other environmental review.
- Oil and gas resources are considered unrecoverable in areas designated unavailable for leasing. They would also be considered unrecoverable in areas open to leasing but where surface use constraints prohibit development operations on areas larger than can be technically and economically developed from offsite locations. Oil and gas resources within leased in-holdings would be considered recoverable.

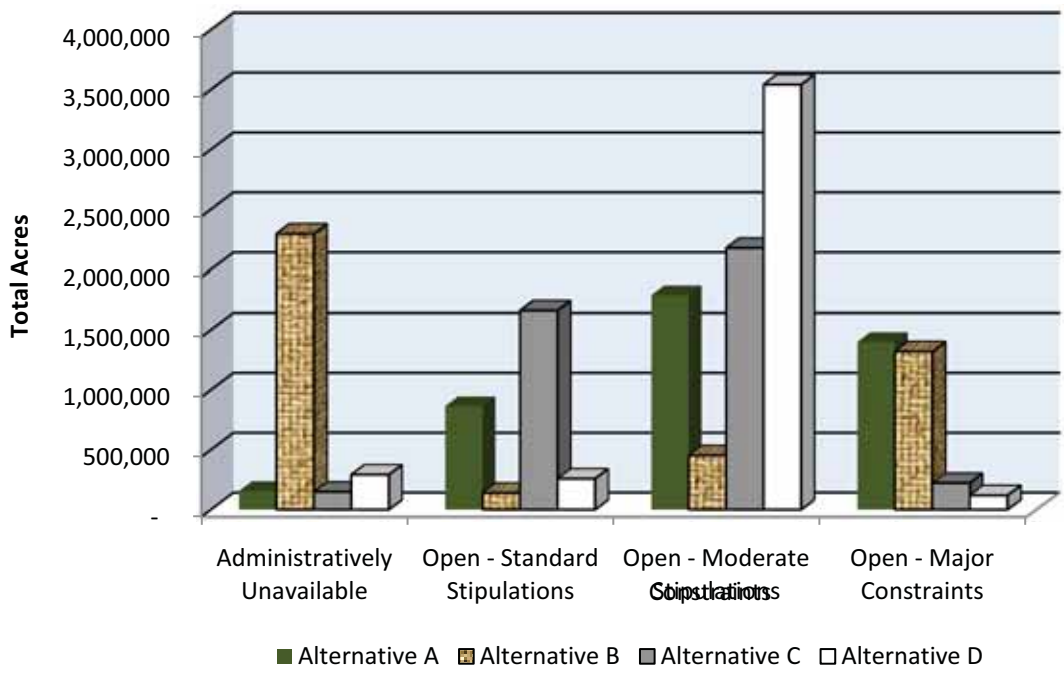
- Oil and gas development potential is based on the following categories:
    - High potential for hydrocarbon development indicates areas where the average well density is anticipated to be more than 100 wells per township.
    - Moderate potential for hydrocarbon development indicates areas where the average well density is anticipated to be between 20 and 100 wells per township.
    - Low potential for hydrocarbon development indicates areas where the average well density is anticipated to be 2 to fewer than 20 wells per township.
    - Very low potential for hydrocarbon development indicates areas where the average well density is anticipated to be fewer than 2 wells per township.
    - No potential for hydrocarbon development indicates areas where no wells are anticipated.
- Directional drilling viability and offset distance varies with the target formation, the top depth of the target formation, and formation productivity. Directional drilling distances of ¼ mile are assumed to be standard practice in most formations with current technology.
- For the purposes of this analysis, hydrocarbon resources more than ½ mile inside the boundary of an NSO area would generally be unrecoverable.
- Directional drilling potentially increases well development costs by approximately 10 percent to 15 percent for offset distances of up to 2,000 feet (Eustes 2003).
- Directional drilling can increase the risk of unrecoverable hydrocarbon resources in cases when the drill stem gets irretrievably stuck and the production casing cannot be set to the bottom of the production formation.

4.2.5.2 Summary of Impacts by Alternative

Management actions that restrict or constrain the potential for oil and gas leasing, development, and exploration (via NSO, CSU, and TLS restrictions or managing areas as administratively unavailable) would result in adverse impacts; management actions that ease restrictions or maintain areas as open for oil and gas exploration and development would result in beneficial impacts. All of the alternatives include management that restricts oil and gas leasing and development to varying levels; Alternative B would generally result in the most adverse impacts to oil and gas development and Alternative C the least. Figure 4-3 displays the acreage open to oil and gas development subject to the standard lease form, open with constraints, and administratively unavailable under each alternative. Areas administratively unavailable for oil and gas development are smallest under Alternative C (147,760 acres) and largest under Alternative B (2,296,279 acres). Alternative C has the largest amount of area open to oil and gas development subject to the standard lease form only, followed by alternatives A, D, and B. Areas open with moderate and major constraints are largest under Alternative D, followed by alternatives A, C, and B (because most of the Planning Area is administratively unavailable under Alternative B). Impacts to oil and gas exploration and development from the restriction of geophysical exploration would be the greatest under Alternative B due to limits on motorized vehicle use and restrictions on surface-disturbing activities. Adverse impacts result when management of special designations (e.g., ACECs and National Historic Trails [NHTs]) places restriction on oil and gas leasing or makes areas administratively unavailable for oil and gas leasing (see Table 4-6). Additionally, the BLM manages Wild Lands as administratively unavailable for oil and gas leasing under alternatives B (565,868 acres of federal mineral estate) and D (47,469 acres of federal mineral estate), except for the Painted Hills Wild Land under Alternative D which is available for leasing with an NSO restriction. Alternatives C and D establish Oil and Gas Management Areas (568,164 acres and 134,214 acres, respectively) allowing full development of known oil and gas resources in existing fields and exempting these areas from seasonal development

and other restrictions, resulting in beneficial impacts to oil and gas exploration and development. As shown in Table 4-7, alternatives B and D are the only alternatives where areas managed as administratively unavailable to oil and gas leasing include some areas with moderate development potential (219,821 acres and 2,834 acres, respectively). The development potential for leasable oil and gas in the Planning Area ranges from moderate to no potential, depending on location.

Figure 4-3. Oil and Gas Constraints by Alternative



Source: BLM 2009a

Table 4-6. Acres of Federal Mineral Estate Closed or Administratively Unavailable for Oil and Gas Leasing due to Special Designations and Other Management Areas[1]

Type of Area	Alternative A	Alternative B	Alternative C	Alternative D
Wilderness Study Areas	142,031	142,031	142,031	142,031
Wild Lands	0	565,868	0	47,469
National Historic Trails	0	0	0	0
National Historic Landmark	0	12,506	833	833
Areas of Critical Environmental Concern	11,928	340,863	8,560	78,993
Wild and Scenic Rivers	14,330	21,863	0	0
Absaroka Front Management Area	0	217,122	0	85,634
Special Recreation Management Areas	0	0	0	0

Source: BLM 2009a

[1]Acreages provided indicate areas administratively unavailable or closed to leasing as a direct result of the management of the special designation or other management area. Other areas may be administratively unavailable or closed to leasing as a result of other overlapping resource considerations.

Table 4-7. Acres of Oil and Gas Development Potential and Constraints by Alternative

Development Potential	Constraint	Alternative A	Alternative B	Alternative C	Alternative D
Moderate	Closed or Administratively Unavailable[1]	0	219,821	0	2,834
	Standard Stipulations	82,703	10,228	128,933	18,775
	Moderate Constraints	164,105	31,726	203,238	319,310
	Major Constraints	97,731	82,764	12,368	3,621
Low	Closed or Administratively Unavailable[1]	0	887,853	0	3,689
	Standard Stipulations	416,271	81,158	905,847	83,789
	Moderate Constraints	828,800	167,729	797,216	1,656,939
	Major Constraints	547,837	656,169	89,846	48,491
Very Low	Closed or Administratively Unavailable[1]	9,373	978,427	5,752	93,149
	Standard Stipulations	338,930	47,605	579,249	133,078
	Moderate Constraints	759,059	234,633	1,122,828	1,531,662
	Major Constraints	713,710	560,407	113,243	63,183
None	Closed or Administratively Unavailable[1]	3,479	68,087	0	52,624
	Standard Stipulations	25,646	48	48,380	20,862
	Moderate Constraints	37,649	17,859	52,524	30,782
	Major Constraints	40,126	20,908	5,997	2,672

Source: BLM 2009a

[1] There are no oil and gas development potential data for Wilderness Study Areas (143,974 acres), and the data in this table do not reflect those areas. All Wilderness Study Areas are closed to new leasable mineral exploration and development (BLM Manual 8550 - Interim Management Policy and Guidelines for Lands Under Wilderness Review).

4.2.5.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Under all alternatives, management that results in areas being open, open with constraints, or administratively unavailable would respectively allow, limit, or prohibit exploration and development in certain areas. This management would result in direct impacts to oil and gas development. Impacts would be similar across alternatives because the definition of areas open subject to the standard lease form, open with moderate constraints, open with major constraints, and administratively unavailable are the same for all alternatives (see *Glossary*). The severity of these impacts would vary by alternative based on amount of acreage and associated oil and gas development potential. Protective measures for other resources, including limiting or prohibiting access and development or controlling the timing or

nature of development, would result in adverse impacts. Restrictions on oil and gas development under each of the alternatives also would result in adverse impacts to the rate of oil and gas exploration, development, and extraction. These impacts would increase costs, both to the operator and the product end user, of exploring for, developing, and extracting oil and gas. Under all alternatives, operators must employ BMPs in the exploration, development, production, and abandonment of oil and gas resources.

Under all alternatives, areas administratively unavailable to oil and gas leasing would be closed to geophysical exploration and areas open to oil and gas leasing would be open to geophysical exploration. Managing areas as administratively unavailable would prohibit oil and gas exploration and subsequent development and extraction. This would result in adverse impacts to exploration and development of fluid mineral resources. Alternatively, allowing geophysical exploration in areas open to oil and gas development would result in beneficial impacts to oil and gas exploration and development. Requiring geophysical exploration to be performed within the constraints necessary to protect other resources (e.g., NSO or CSU restrictions) may result in adverse impacts to oil and gas exploration, but could benefit other resources. Adverse impacts to exploration would include increased costs to the operator from the use of more expensive, but less surface-disturbing techniques (e.g., small, portable foot- or helicopter-transported surveying equipment in areas with surface use restrictions). If surface use restrictions prevent an operator from effectively surveying/exploring oil and gas resources, development could be sited based on incomplete information, affecting the potential success of a future well. This also could result in increased costs to the operator and in nonproductive disturbances to land and surface resources.

In areas where federal oil and gas leases are or have been issued without stipulations, subsequently placing additional mitigation measures on exploration and development may result in adverse impacts to ongoing or future oil and gas development. Requiring additional stipulations on new leases may constrain exploration, development, production, or other actions that increase the timeframe and cost of operations. Mitigating measures attached to an APD as COA influence how an activity is accomplished, but rarely preclude the activity. Such management actions in complex areas involving impact avoidance to several resources may limit oil and gas operations.

Special designations (e.g., ACECs, NHTs, WSAs) and other management areas (e.g., recreation management areas) may result in adverse impacts to oil and gas exploration and development, depending on their location in relation to oil and gas development potential. These lands may be subject to a variety of restrictions related to oil and gas exploration or development, or require certain BMPs or mitigation to preserve resource and management objectives in these areas. Restrictions, subject to buffer zones of varying sizes, affecting oil and gas include restrictions that close or make these areas administratively unavailable, NSO restrictions over all or portions of specific areas, or CSU restrictions. Special stipulations, such as required resource surveys, also may be applied. Discussions of overall constraints for oil and gas for each alternative capture impacts from these special designations. Respective sections in this chapter discuss specific impacts of the management for each area.

Management actions that prescribe certain BMPs and mitigation would affect all alternatives on a project-specific basis, depending on the overall constraints under each alternative. While specific mitigation measures generally would be consistent, the nature and level of impacts to oil and gas development would vary among alternatives and may also vary based on site-specific conditions that would be evaluated in implementation-level environmental documents. In general, constraints on exploration, development, production, and abandonment of oil and gas resources (e.g., NSO, CSU, or TLS) would increase project timeframes and costs, and may limit the number of well pads and amount of

surface disturbance on a lease. This would be an adverse impact. However, such constraints may result in beneficial impacts to other resources in a given area.

Under all alternatives, implementing mitigation measures to reduce air quality emissions from current levels and applying BMPs for oil and gas activities that could affect groundwater resources would require certain technologies and mitigation that may increase project costs. This would result in adverse impacts to oil and gas development.

On split-estate lands (areas with private surface ownership and federal mineral estate), determination of access road and well pad locations in conjunction with the surface owner may result in adverse impacts to oil and gas exploration or development. Such adverse impacts may result from an increase in the timeframe for processing and developing leases, increasing project costs, or the potential relocation of well pads and infrastructure. However, such consultations also could benefit an oil and gas operation in the long term as a result of the benefits of collaborating with the surface owner.

When necessary to protect important habitats, the BLM would attach COA for operations proposed on existing oil and gas leases within areas designated as unavailable for leasing, which would exclude surface occupancy and surface disturbance. The BLM would do this to the maximum extent possible without violating lease rights. Such restrictions on occupancy and surface disturbance may limit the operator's ability to extract the federal oil and gas resources under lease. For example, directional drilling from an area outside such a lease to an operator-targeted bottom-hole location in a leased area may not be technically or economically feasible.

Under all alternatives, the BLM would require special status species inventories for surface-disturbing projects in known or suspected special status species habitat. Postponing or modifying projects that may affect special status species would lead to a delay in the development and/or the relocation of well pads, access roads, pipelines, or ancillary facilities.

Typical impacts from cultural resource management actions on oil and gas exploration and development would include increased well development costs associated with cultural resource inventories, relocation of projects (well pads, roads, pipelines) to avoid a cultural site, implementation of offsite drilling (directional drilling) techniques, and/or site excavation if avoidance is not possible. Discovery of previously undocumented cultural features during project construction would delay project implementation while the site is evaluated.

Under all alternatives, management actions for ROWs would allow, limit, or prohibit facilities and infrastructure necessary for the development and extraction of oil and gas resources including access roads, powerlines, and pipelines. This would impact oil and gas development. Federal regulations require ROW grants for access roads, powerlines, or pipelines that cross one lease to access another. Avoiding or excluding these authorizations could limit or prohibit legal access and infrastructure to well pads. Management that limits or prohibits ROW authorizations (ROW avoidance/mitigation and exclusion areas) would result in adverse impacts to oil and gas development. Designating ROW corridors up front could eliminate or reduce land use conflicts and beneficially affect oil and gas development and pipelines.

Oil and gas exploration and development often occur in grazing allotments. Oil and gas operators would have to abide by mitigation specified in lease stipulations or in the COA for those operations. Mitigation measures required to minimize adverse impacts to livestock grazing would increase the cost of oil and gas exploration and development. These measures would include providing for the upkeep and repair of fences and gates and taking measures to prevent loss of or injury to livestock. The BLM would not expect livestock mitigation to substantially affect the technical or economic viability of oil and gas development.

Reclaiming areas of surface disturbance with native grass and forb species to prevent erosion; monitoring and treating weeds and other nonnative, invasive plant species that occupy areas disturbed by oil and gas development and production; and returning vegetation and habitat to pre-disturbance conditions is required in all cases, increasing project costs.

Under all alternatives, the extent of impacts to oil and gas development from constraints and limitations on exploration and development relates directly to oil and gas development potential in an area. Management actions that constrain development of oil and gas in high-potential areas generally would result in more impacts to development than similar management actions that constrain development in low-potential areas. The RFD for oil and gas describes the potential for oil and gas occurrence and development in the Planning Area (BLM 2009e).

Alternative A

Resource Uses

Under Alternative A, 154,861 acres of BLM-administered mineral estate would be administratively unavailable for mineral leasing (Map 17). Managing areas as administratively unavailable for oil and gas leasing would reduce the amount of land available for oil and gas leasing and prohibit development in these areas. This would result in direct adverse impacts to oil and gas development.

Under Alternative A, 1,399,490 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and major constraints (Map 17). Major constraints to oil and gas exploration and development, such as NSO restrictions or overlapping TLS restrictions, limit or prohibit development in these areas or require certain drilling techniques, BMPs, or other mitigation. This results in adverse impacts to oil and gas exploration and development. In some cases, operations can be modified to accommodate such restrictions, but these modifications can be costly, increase project timeframes, or be otherwise undesirable to oil and gas operators. Companies typically drill oil and gas wells vertically because the costs are lower and drilling problems are less likely, but they could employ directional drilling in an area with an NSO restriction to protect other resources. For example, an operator might be able to place a well pad, access road, or production facility in a less sensitive area and drill the well directionally to recover reserves underlying the area with the NSO if under certain conditions, such as favorable geologic and drilling conditions. However, even if technically feasible, the increased costs associated with directional drilling may make some drilling activities uneconomical. Because directional drilling has certain limitations, operators may not be able to develop all the oil and gas resources from all the acreage associated with large NSO areas. Companies typically cannot use directional drilling to develop CBNG because the reservoirs are too shallow (BLM 2009e). Because of the costs associated with restrictions, an operator may decide to not develop oil and gas resources in an area with major constraints.

Under Alternative A, 1,789,634 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and moderate constraints (Map 17). Moderate constraints limit the time of construction and operation activities or require specific mitigation or lease stipulations. This would result in adverse impacts to oil and gas leasing. Moderate constraints do not necessarily remove the area from development or exploration of oil and gas or require directional drilling. Under TLS restrictions, development may become more intensive over a shorter period to complete operations before timing restrictions apply. In areas with overlapping TLS restrictions, companies may be limited to narrow timeframes to complete work, which may result in major constraints. In some cases, an operator may have to start development and then postpone operations during specific periods. If the window during which work can be done is too short, a development

project may have to proceed in phases, requiring more time to complete, adding to the project's cost, and increasing the time before the investment is recovered. CSU restrictions could require specific lease stipulations to meet other resource management objectives and make the development of oil and gas uneconomical or unattractive to potential operators.

Under Alternative A, 863,564 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form only (Map 17). Managing areas open to oil and gas exploration and development allows oil and gas leasing and development in these areas with only standard lease stipulations. This would result in beneficial impacts.

As a result of the oil and gas constraints under Alternative A, projected drilling is reduced from the baseline unconstrained projections. The baseline scenario projects 1,354 federal wells could be drilled in the Planning Area. These include 1,249 conventional wells and 105 CBNG wells. Under Alternative A, 1,130 wells are projected (1,045 conventional wells and 85 CBNG wells). This represents an approximately 17-percent decrease from the baseline, or 204 fewer federal conventional wells and 20 fewer federal CBNG wells. Under Alternative A, 181 fewer federal oil and gas wells are expected to remain in production at the end of the planning period compared to the projected baseline scenario. This represents an approximately 5-percent decrease from the baseline scenario. Abandonment of federal wells is expected to decrease slightly (approximately 5 percent), from 957 wells under the baseline scenario, to 914 wells under Alternative A (BLM 2009e).

Designating ROW exclusion and avoidance/mitigation areas would prohibit or limit ROW authorizations for roads, pipelines, or other infrastructure that may be necessary for the development of oil and gas resources. This would result in adverse impacts to oil and gas development. Under Alternative A, the BLM manages 941,778 acres as ROW avoidance/mitigation areas and 61,416 acres as ROW exclusion areas.

Special Designations

Special designations (ACECs, NHTs, WSAs, and WSRs) under Alternative A may result in adverse impacts to oil and gas exploration and development. However, because these areas are generally small, the impacts to overall use of oil and gas resources would generally be limited. In addition to WSAs, Alternative A makes portions of some ACECs and some WSR eligible waterway segments administratively unavailable for oil and gas leasing (Table 4-6). Alternative A also manages areas within ¼ mile of the Nez Perce (Neeme-poo) NHT and Other Historic Trails, seven WSR eligible waterway segments, and the Red Gulch Dinosaur Tracksite ACEC, Big Cedar Ridge, Five Springs Falls, and Upper Owl Creek ACECs as available for oil and gas leasing with an NSO restriction.

Resources

Under Alternative A, restrictions and constraints on oil and gas development would result from management actions to protect resources. The most extensive impacts to oil and gas leasing from management of resources under Alternative A would result from restrictions for greater sage-grouse, raptor nesting, and big game crucial winter range.

Under Alternative A, adverse impacts to oil and gas development would result from management of greater sage-grouse leks, nesting and early brood-rearing habitat, and winter concentration areas on new and existing leases, including:

- CSU restrictions within ¼ mile of occupied leks (30,886 acres)
- TLS restrictions in early brood-rearing habitats within 2 miles of occupied leks (1,009,963 acres)

- TLS restrictions in identified nesting and brood-rearing habitat outside the 2-mile buffer from March 15 to July 15 (CYFO seasonal restrictions are from February 1 to July 31)
- TLS restrictions within winter concentration areas from November 15 to March 14

These restrictions would impose moderate constraints to oil and gas development, which would result in adverse impacts. The impacts of these restrictions would vary across the Planning Area, depending on the projected development potential for oil and gas resources. For BLM-administered lands, management that constrains oil and gas development around greater sage-grouse leks, in nesting and early brood-rearing habitat, and in winter concentration areas would affect approximately 115,458 acres of moderate-potential areas, 521,785 acres of low-potential areas, and 522,797 acres of very-low-potential areas. Restrictions applied in low- and very-low-potential areas may result in only limited impacts to oil and gas development. Impacts to oil and gas development from restrictions that constrain development in moderate-potential areas would be greater than restrictions that constrain development in low- and very-low-potential areas.

Under Alternative A, restrictions on surface disturbances (i.e., TLS stipulations) in raptor nesting areas would prohibit development or require lease stipulations that may make oil and gas development more difficult. This would result in adverse impacts to oil and gas resources. Under Alternative A, designated raptor nest buffer areas would include approximately 338,731 acres of BLM-administered surface. Timing restrictions on surface-disturbing activities in these areas would narrow the available time for construction activities and potentially increase project costs. This may adversely affect oil and gas development. Under Alternative A, TLS restrictions for raptor nesting areas would occur on approximately 47,358 acres with moderate oil and gas development potential, 149,432 acres with low potential, and 126,181 acres with very low potential. As with oil and gas restrictions for greater sage-grouse habitat, impacts from TLS restrictions for raptor nest areas in moderate-potential areas would be greater than restrictions in low- and very-low-potential areas.

Under Alternative A, TLS restrictions in big game crucial winter range (1,313,731 acres) and big game parturition habitat (81,770 acres) would reduce the time available for oil and gas activities and potentially increase project timeframes and costs. This would result in adverse impacts to oil and gas resources. In addition, applying CSU restrictions for big game migration corridors, narrow ridges, overlapping big game crucial winter range (319,522 acres), and big game parturition habitat (81,770 acres) in the Absaroka Front Area would require lease stipulations that may increase project timeframes and costs. This would result in adverse impacts to oil and gas resources.

Alternative A prohibits surface-disturbing activities within 500 feet of surface water and riparian/wetland areas (55,586 acres). Prohibiting surface disturbance in these areas would exclude ROWs in these areas and prohibit the development of oil and gas resources, which would result in adverse impacts to oil and gas development.

Of the areas available for oil and gas leasing, 326,950 acres are in VRM Class II areas, 884,962 are in VRM Class III areas, and 1,793,466 are in VRM Class IV areas. In VRM Class I areas, the level of change to the characteristic landscape should be very low; therefore, VRM Class I areas are closed to oil and gas leasing. In VRM Class II areas, the level of change to the characteristic landscape should be low. Oil and gas exploration and development activities may be restricted or limited in VRM Class II areas. VRM objectives in Class II areas may limit the development of facilities. If the BLM approves oil and gas development in these areas, siting, design, and other mitigation may be required to ensure that management objectives for visual resources are met. Objectives for VRM Class III, Class IV, or unclassified area generally allow activities, subject to some level of mitigation.

The nature and extent of impacts to the oil and gas resources from VRM would vary according to the projected oil and gas development potential of the subject lands. Of the areas available for oil and gas leasing, VRM Class II areas include approximately 14,128 acres with a moderate potential for oil and gas resources, approximately 42,428 acres with a low potential for oil and gas resources, and approximately 245,815 acres with a very low potential for oil and gas resources. Impacts to oil and gas development from management as VRM Class II would be greater in moderate-potential lands than in low- and very-low-potential lands, because moderate-potential lands are more likely to be developed than low- and very-low-potential lands.

Alternative B

Resource Uses

Under Alternative B, geophysical exploration is subject to limitations on motorized vehicle use and restrictions on surface-disturbing activities. This would result in adverse impacts to oil and gas development by limiting the access and methods used for oil and gas resource surveys.

Under Alternative B, 2,296,279 acres of BLM-administered mineral estate would be administratively unavailable for mineral leasing (Map 18). Managing areas as administratively unavailable to mineral leasing would result in adverse impacts similar to those described for Alternative A, although to a greater extent. Implementing Alternative B would result in a substantial increase in area administratively unavailable to oil and gas leasing compared to Alternative A (154,861 acres), Alternative C (147,760 acres), and Alternative D (291,294 acres).

Under Alternative B, 1,320,277 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and major constraints (Map 18). Managing areas with major constraints would result in adverse impacts similar to those described for Alternative A, although to a slightly lesser extent due to smaller acreage. Implementing Alternative B would result in a 6-percent decrease in area managed with major constraints compared to Alternative A, a 496-percent increase compared to Alternative C, and a 1,019-percent increase compared to Alternative D.

Under Alternative B, 451,948 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and moderate constraints (Map 18). Managing areas with moderate constraints would result in adverse impacts similar to those described for Alternative A, although to a lesser extent. Implementing Alternative B would result in a 75-percent decrease in area managed with moderate constraints compared to Alternative A, a 79-percent decrease compared to Alternative C, and an 87-percent decrease compared to Alternative D. Managing more area as unavailable to mineral leasing and with major and moderate oil and gas constraints would likely result in increased oil and gas development on private lands under Alternative B, compared to the other alternatives.

Under Alternative B, 139,045 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form only (Map 18). Managing areas as open to oil and gas leasing subject to the standard lease form would result in beneficial impacts to oil and gas resources similar to those described for Alternative A, although to a lesser extent. Implementing Alternative B would result in an 84-percent decrease in area open subject to the standard lease form compared to Alternative A, a 92-percent decrease compared to Alternative C, and a 46-percent decrease compared to Alternative D.

As a result of the restrictions implemented under Alternative B, projected drilling is reduced from baseline projections. The baseline scenario projects that 1,354 federal wells could be drilled (1,249 conventional wells and 105 CBNG wells). Under Alternative B, 509 wells are projected (470 conventional

wells and 39 CBNG wells). This represents an approximately 62-percent decrease from the baseline, or 779 fewer federal conventional wells and 66 fewer federal CBNG wells. Six-hundred eighty-three (683) fewer federal wells (both conventional and CBNG) are expected to remain in production at the end of the planning period. This represents an approximately 20-percent decrease from the baseline. Abandonment of federal wells is similarly expected to decrease (approximately 17 percent) from 957 wells under the baseline scenario to 795 wells under Alternative B (BLM 2009e). At the end of the planning period, projected total producing wells would be the least under Alternative B (2,680) compared to Alternative A (3,182), Alternative C (3,283), and Alternative D (3,100).

Under Alternative B, the BLM does not suspend existing non-producing oil and gas leases in areas closed to mineral leasing and, after such leases expire, would not offer the land for future leasing. This management may result in adverse impacts to the production of federal oil and gas where such resources are present. The respective terms (expiration dates) of such leases cannot be halted at the direction or consent (after application for suspension by the lessee or operator) of the BLM authorized officer, as would be the case if the leases were suspended. This would be the case even if lease suspension was in the interest of conservation of natural resources, encouraged the greatest ultimate recovery of oil and gas, or met other criteria warranting lease suspension (see 43 CFR 3135.2).

Managing areas as ROW avoidance/mitigation and exclusion areas would result in adverse impacts similar to those described for Alternative A, although to a greater extent. Under Alternative B, the BLM manages 2,717,617 acres as ROW avoidance/mitigation areas and 225,750 acres as ROW exclusion areas. The total acreage managed as ROW avoidance/mitigation and exclusion is greater than under the other alternatives.

Under Alternative B, geophysical exploration is subject to limitations on motorized vehicle use. Areas closed to motorized vehicle use (136,474 acres) and areas where motorized vehicle use is limited to designated roads and trails (2,054,228 acres) would restrict access routes in the Planning Area and may limit the use of seismic technology to obtain subsurface stratigraphic and structural information useful for exploration of oil and gas reserves. This would result in adverse impacts to oil and gas development.

Special Designations

Compared to the other alternatives, Alternative B includes more special designations and management areas (including recreation management areas) and places more restrictions on surface-disturbing activities in these areas. This results in more adverse impacts to the development of oil and gas resources. Management in these areas includes closing land to mineral leasing, and NSO and CSU restrictions. Because these areas are larger and have more restrictions, impacts to oil and gas exploration and development are expected to be more extensive than under the other alternatives. Table 4-6 shows the acreage of closures and areas administratively unavailable for oil and gas leasing due to special designations and other management areas under this alternative. Other impacts from these special designations (NSOs, TLS, and CSUs) are captured in the overall constraints for oil and gas under this alternative described above, and specific management for each area (e.g., ACECs or SRMAs) is discussed in its respective section.

Resources

Restrictions and constraints on oil and gas development resulting from management actions to protect resources would be the greatest under Alternative B. The most extensive impacts to oil and gas leasing from management of resources under Alternative B would result from restrictions for greater sage-grouse, raptor nesting, and big game crucial winter range.

Under Alternative B, quantitative air quality modeling of oil and gas field development would be required to determine potential impacts from proposed emissions sources. Air quality modeling of potential oil and gas development may require mitigation strategies for projects that would exceed emission standards.

The most extensive impacts to oil and gas leasing would result from protective restrictions for greater sage-grouse. Under Alternative B, adverse impacts to oil and gas development would result from management of greater sage-grouse leks, nesting and early brood-rearing habitat, and winter concentration areas on future and existing leases including:

- TLS restrictions in nesting and early brood-rearing habitat within 3 miles of occupied leks (1,571,115 acres) from February 1 to July 31
- TLS restrictions in nesting and early brood-rearing habitat outside the 3-mile lek buffer from February 1 to July 31
- CSU restrictions for all seasonal habitats identified above to allow 1 to 15 acres of well location or 15 acres of habitat removal per 640-acre section

Also under Alternative B, adverse impacts to oil and gas development on new leases would result from:

- NSO restrictions in 0.6 mile of occupied greater sage-grouse leks (157,008 acres)
- NSO restrictions in winter concentration areas from November 15 to March 14
- The designation of greater sage-grouse Key Habitat Areas as administratively unavailable to mineral leasing (1,226,064 acres)

These restrictions would result in adverse impacts by prohibiting oil and gas development or managing areas with moderate or major constraints to development. The impacts of these restrictions would vary across the Planning Area, depending on the projected development potential for oil and gas. For BLM-administered lands, management that constrains oil and gas development around greater sage-grouse leks, in nesting and early brood-rearing habitat, and in winter concentration areas would affect approximately 186,560 acres of moderate-potential areas, 822,520 acres of low-potential areas, and 797,395 acres of very-low-potential areas. Restrictions applied in low- and very-low-potential areas may result in only limited impacts to oil and gas development. Impacts to oil and gas development from restrictions that constrain development in moderate-potential areas would be greater than restrictions that constrain development in low- and very-low-potential areas. Because these constraints would affect a larger area of moderate development potential than under the other alternatives, adverse impacts to oil and gas from management of greater sage-grouse would be greater under Alternative B than under the other alternatives.

Limiting noise sources at the perimeter of occupied greater sage-grouse leks may require mitigation or technologies that reduce noise levels, which may increase project costs. This may result in adverse impacts to oil and gas development. Oil and gas development activities may be restricted where sound levels cannot be limited below ambient noise levels.

Under Alternative B, restrictions on surface disturbance (including TLS and CSU restrictions) in raptor nesting areas would result in adverse impacts to oil and gas development similar to those described for Alternative A, although to a greater extent due to restrictions in the increased buffer areas. Under Alternative B, raptor nest buffer areas would include approximately 570,506 acres of BLM-administered surface with both CSU and TLS restrictions, which represents an approximately 68-percent increase in area with restrictions compared to Alternative A. Restrictions in raptor nesting areas would occur on approximately 72,659 acres of moderate oil and gas development potential lands, 246,164 acres of low-

potential lands, and 201,583 acres of very-low-potential lands. As a result of specific stipulations for ferruginous hawks, lands where greater sage-grouse and raptor habitats overlap could be subject to development restrictions for most of the year (9 months).

Managing big game crucial winter range (1,313,731 acres) and parturition habitat (81,770 acres) with an NSO restriction would prevent surface occupancy for oil and gas activities, and increase project costs or in some cases result in the inability to access oil and gas resources. This would result in adverse impacts to oil and gas exploration and development. These impacts would be greater under Alternative B than under Alternative A, which manages these areas with TLS restrictions. Managing the Absaroka Front Management Area (106,354 acres) as administratively unavailable to oil and gas leasing would prohibit oil and gas development in this area, which would result in adverse impacts.

Impacts to oil and gas from prohibiting surface disturbance within ¼ mile of riparian/wetland areas (140,464 acres) would result in impacts similar to those described for Alternative A, but to a greater extent due to larger acreages.

Under Alternative B, impacts to oil and gas development from VRM would be similar to those described for Alternative A, although to a greater extent due to more acreage managed as VRM Class I and Class II. Of the areas available for oil and gas leasing, 523,744 acres are in VRM Class II areas, 234,102 acres are in VRM Class III areas, and 554,398 acres are in VRM Class IV areas. The nature and extent of impacts to oil and gas exploration and development from VRM would vary according to the projected development potential of the subject lands. Under Alternative B, of the areas available for oil and gas leasing, VRM Class II areas include approximately 32,756 acres of moderate oil and gas development potential lands, approximately 263,941 acres of low-potential lands, and approximately 214,789 acres of very-low-potential lands. Under Alternative B, VRM Class II areas in moderate development potential areas increase by approximately 132 percent compared to Alternative A.

Alternative C

Resource Uses

Under Alternative C, 147,760 acres of BLM-administered mineral estate would be administratively unavailable for mineral leasing (Map 19). Managing areas as administratively unavailable to mineral leasing would result in adverse impacts similar to those described for Alternative A, although to a lesser extent. Implementing Alternative C would result in a decrease in areas administratively unavailable compared to implementation of Alternative A (154,861 acres), Alternative B (2,296,279 acres), and Alternative D (291,294 acres).

Under Alternative C, 221,536 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and major constraints (Map 19). Managing areas with major constraints would result in adverse impacts similar to those described for Alternative A, although to a lesser extent. Implementing Alternative C would result in an 84-percent decrease in area managed with major constraints compared to Alternative A, an 83-percent decrease compared to Alternative B, and an 88-percent increase compared to Alternative D.

Under Alternative C, 2,175,814 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and moderate constraints (Map 19). Managing areas with moderate constraints would result in adverse impacts similar to those described for Alternative A, although to a greater extent. Implementing Alternative C would result in a 22-percent increase in area managed with moderate constraints compared to Alternative A, a 381-percent increase compared to Alternative B, and a 39-percent decrease compared to Alternative D.

Under Alternative C, 1,662,439 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form only (Map 19). Managing areas as open to oil and gas leasing subject to the standard lease form would result in beneficial impacts to oil and gas resources similar to those described under Alternative A though to a greater extent. Implementing Alternative C would result in a 93 percent increase in area open subject to the standard lease form compared to Alternative A, a 1,096 percent increase compared to Alternative B, and a 546 percent increase compared to Alternative D.

As a result of the restrictions implemented under Alternative C, projected drilling is reduced from the baseline projections. The baseline scenario projects that 1,354 federal wells could be drilled (1,249 conventional wells and 105 CBNG wells). Under Alternative C, 1,257 wells are projected (1,178 conventional wells and 79 CBNG wells). This represents an approximately 7-percent decrease from the baseline, or 71 fewer federal conventional wells and 26 fewer federal CBNG wells. Under Alternative C, 80 fewer federal wells (both conventional and CBNG) are expected to remain in production at the end of the planning period than projected in the baseline scenario. This represents an approximately 2-percent decrease. Abandonment of federal wells is expected to decrease slightly (approximately 2 percent), from 957 wells under the baseline scenario, to 940 wells under Alternative C (BLM 2009e). Projected total producing wells at the end of the planning period would be the greatest under Alternative C (3,283) compared to Alternative A (3,182), Alternative B (2,680), and Alternative D (3,100).

Under Alternative C, the BLM allows suspension of existing oil and gas leases (producing and non-producing) in areas closed to mineral leasing for reasons such as conservation of natural resources, greatest ultimate recovery of oil and gas, or other reasons outlined by regulation (see 43 CFR 3135.2). If the BLM authorized officer grants a suspension, the respective terms (expiration dates) of such leases are extended for the period of suspension. If the BLM authorized officer does not suspend existing non-producing oil and gas leases and allows them to expire, the BLM would not offer lands in these areas for future leasing. This management may result in adverse impacts to production of federal oil and gas where such resources are present. The BLM automatically extends the terms on producing leases (and leases capable of production) in paying quantities if they comply with applicable regulations (see 43 CFR 3107.2).

Under Alternative C, managing areas as ROW avoidance/mitigation or exclusion areas would result in adverse impacts similar to those described for Alternative A, although to a greater extent. Under Alternative C, the BLM manages more acreage (1,174,335 acres) as ROW avoidance/mitigation areas and less acreage (7,762 acres) as ROW exclusion areas. However, the total acreage managed as ROW avoidance/mitigation or exclusion is greater than under Alternative A and less than under alternatives B and D.

Special Designations

Alternative C prescribes fewer restrictions on surface-disturbing and disruptive activities for a smaller number of special designation and management areas (including recreation management areas) compared to the other alternatives. Fewer special designations and fewer restrictions in these areas would result in fewer adverse impacts to oil and gas exploration and development compared to the other alternatives. Table 4-6 shows the acreage of closures and areas administratively unavailable for oil and gas leasing due to special designations and other management areas under this alternative. Other impacts from these special designations (NSOs, TLS, and CSUs) are captured in the overall constraints for oil and gas under this alternative described above, and the specific management for each area (e.g., ACECs or SRMAs) is discussed in its respective section.

Resources

Restrictions and constraints on oil and gas development resulting from management actions to protect resources would be the least under Alternative C. The most extensive impacts to oil and gas leasing from resource management under Alternative C would result from restrictions for greater sage-grouse and raptor nesting areas.

Under Alternative C, there would be adverse impacts to oil and gas development resulting from management of greater sage-grouse leks, nesting and early brood-rearing habitat, and winter concentration areas on new and existing leases (excluding Oil and Gas Management Areas for TLS), including:

- CSU restrictions within ¼ mile of occupied greater sage-grouse leks
- TLS restrictions in greater sage-grouse nesting and early brood-rearing habitat within 2 miles of occupied leks (982,832 acres) from March 15 to July 15
- TLS restrictions in nesting and brood-rearing habitat outside the 2-mile buffer from March 15 to July 15
- TLS restrictions within greater sage-grouse winter concentration areas from November 15 to March 14

These restrictions would impose moderate constraints to oil and gas development, therefore resulting in adverse impacts. The impacts of these restrictions would vary across the Planning Area, depending on the projected development potential for oil and gas. For BLM-administered lands, management that constrains oil and gas development around greater sage-grouse leks and in nesting and early brood-rearing habitat and winter concentration areas would affect approximately 115,458 acres of moderate oil and gas development potential areas, 521,785 acres of low-potential areas, and 522,797 acres of very-low-potential areas. These restrictions affect the same area as Alternative A and would therefore result in similar impacts.

Limiting noise sources at the perimeter of occupied greater sage-grouse leks would result in adverse impacts to oil and gas development similar to those described for Alternative B, although to a lesser extent due to the reduced time that this stipulation would apply and the exemption of oil and gas management areas from this stipulation.

Raptor nest buffer areas are smaller under Alternative C, occupying approximately 82,294 acres of the Planning Area as a whole. Approximately 53,336 acres of BLM-administered surface are within raptor nest buffer areas. These lands are subject to TLS stipulations prohibiting surface-disturbing or disruptive activities within ¼ mile of active nests from February 1 through July 31. Raptor nesting areas affect approximately 7,908 acres with moderate oil and gas development potential lands, 20,056 acres with low-potential lands, and 17,144 acres with very-low-potential lands.

Alternative C would result in the least impact from wildlife restrictions. Alternative C exempts Oil and Gas Management Areas (568,164 acres) and ROW corridors from discretionary wildlife seasonal stipulations, and opens the Absaroka Front Management Area (106,354 acres) to oil and gas leasing and development, unlike alternatives B and D, which restrict oil and gas development in the area to protect wildlife habitat.

In contrast to the other alternatives, Alternative C would not prohibit or require avoidance of surface-disturbing activities in flood plains or riparian/wetland areas. Instead, the BLM authorizes surface-disturbing activities in these areas on a case-by-case basis, resulting in the fewest adverse impacts to oil and gas development in these areas of any alternative.

The types of impacts to oil and gas development from VRM would be similar to those described for Alternative A, although the extent of these impacts would be smaller because the BLM manages less area as VRM Class I and Class II under this alternative. Of the areas available for oil and gas leasing, 322,539 acres are in VRM Class II areas, 508,329 acres are in VRM Class III areas, and 2,181,175 acres are in VRM Class IV areas. The nature and extent of impacts from VRM on oil and gas exploration and development would vary according to the development potential of the subject lands. Of the areas available for oil and gas leasing, VRM Class II areas include approximately 1,888 acres with moderate oil and gas development potential. Approximately 17,619 acres are classified as low-potential lands and approximately 265,094 acres are classified as very-low-potential lands. Under Alternative C, VRM Class II areas in moderate development potential areas decrease by approximately 87 percent compared to Alternative A.

Proactive Management

Establishing Oil and Gas Management Areas (Map 21; 568,164 acres) around intensively developed existing fields (Map 23) would allow for full development of known oil and gas resources in existing field areas. This would result in beneficial impacts to oil and gas exploration and development. The BLM would manage these areas primarily for oil and gas exploration and development and consider all other surface uses secondary. Exempting Oil and Gas Management Areas and ROW corridors from discretionary wildlife seasonal stipulations would result in beneficial impacts to oil and gas development and associated infrastructure in these areas. Oil and gas operators would be able to work in these areas throughout the year, which may provide some stability to what would otherwise be cyclic development due to wildlife-based seasonal restrictions.

Alternative D

Resource Uses

Under Alternative D, geophysical exploration is subject to limitations on motorized vehicle use and restrictions on surface-disturbing activities, resulting in similar adverse impacts as Alternative B.

Under Alternative D, 291,294 acres of BLM-administered mineral estate would be administratively unavailable for mineral leasing (Map 20). Managing areas as administratively unavailable to mineral leasing would result in adverse impacts similar to those described for Alternative A, although to a slightly greater extent. Implementing Alternative D would result in an increase in area administratively unavailable compared to Alternative A (154,861 acres) and Alternative C (147,760 acres).

Under Alternative D, 117,968 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and major constraints (Map 20). Managing areas with major constraints would result in adverse impacts similar to those described for Alternative A, although to a lesser extent. Implementing Alternative D would result in a 92-percent decrease in area managed with major constraints compared to Alternative A, a 91-percent decrease compared to Alternative B, and a 47-percent decrease compared to Alternative C.

Under Alternative D, 3,540,775 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form and moderate constraints (Map 20). Managing areas with moderate constraints would result in adverse impacts similar to those described for Alternative A, although to a greater extent. Implementing Alternative D would result in a 98-percent increase in area managed with moderate constraints compared to Alternative A, a 683-percent increase compared to Alternative B, and a 63-percent increase compared to Alternative C.

Under Alternative D, 257,512 acres of federal mineral estate are open to oil and gas leasing subject to the terms and conditions of the standard lease form only (Map 20). Managing areas as open to oil and gas leasing subject to the standard lease form would result in beneficial impacts to oil and gas resources similar to those described for Alternative A, although to a lesser extent. Implementing Alternative D would result in a 70-percent decrease in area open subject to the standard lease form compared to Alternative A, an 85-percent increase compared to Alternative B, and an 85-percent decrease compared to Alternative C.

As a result of the restrictions implemented under Alternative D, projected drilling is reduced from the baseline projections. The baseline scenario projects that 1,354 federal wells could be drilled (1,249 conventional wells and 105 CBNG wells). Under Alternative D, 1,032 wells are projected (979 conventional wells and 53 CBNG wells). This represents an approximately 24-percent decrease from the baseline, or 270 fewer federal conventional wells and 52 fewer federal CBNG wells. Under Alternative D, 263 fewer federal wells (both conventional and CBNG) are expected to remain in production at the end of the planning period than projected in the baseline scenario. This represents an approximately 8-percent decrease. Abandonment of federal wells is expected to decrease (approximately 6 percent) from 957 wells under the baseline scenario, to 898 wells under Alternative D (BLM 2009e). The projected number of total producing wells at the end of the planning period under Alternative D (3,100) would be less than under Alternative C (3,283) and Alternative A (3,182), but more than under Alternative B (2,680).

Under Alternative D, the BLM prohibits the suspension of existing, non-producing oil and gas leases on a case-by-case basis in areas closed to mineral leasing, resulting in impacts similar to those under Alternative B.

Managing areas as ROW avoidance/mitigation and exclusion areas would result in adverse impacts similar to those described for Alternative A, although to a greater extent. Under Alternative D, the BLM manages more acreage (2,512,202 acres) as ROW avoidance/mitigation areas but less acreage (39,003 acres) as ROW exclusion areas. The total acreage managed as ROW avoidance/mitigation or exclusion areas is more than under alternatives A and C, but less than under Alternative B.

Geophysical exploration is subject to limitations on motorized vehicle use under Alternative D, which would result in impacts similar to Alternative B, although to a lesser extent because less area is closed or limited to designated roads and trails.

Special Designations

Alternative D closes more areas to mineral leasing and prescribes more restrictions on surface-disturbing and disruptive activities for special designations and management areas (including Wild Lands) than alternatives A and C, but less than Alternative B. Management in these areas includes closing land to mineral leasing, and NSO and CSU restrictions. Impacts from restrictions in special designations would be similar to those under Alternative A, although to a greater extent because of the size of the affected area. Table 4-6 shows the acreages of closures and areas administratively unavailable for oil and gas leasing due to special designations and other management areas under this alternative. Other impacts from these special designations (NSOs, TLS, and CSUs) are captured in the overall constraints for oil and gas under this alternative described above, and the specific management for each area (e.g., ACECs or SRMAs) is discussed in its respective section.

Resources

Restrictions and constraints on oil and gas development resulting from management actions to protect resources would adversely impact oil and gas leasing under Alternative D. The most extensive impacts

from management of resources under Alternative D would result from restrictions for greater sage-grouse and raptor nesting.

Under Alternative D, constraints on resource uses in greater sage-grouse Key Habitat Areas would be more restrictive to oil and gas development than constraints outside Key Habitat Areas, and therefore would result in greater adverse impacts. Managing greater sage-grouse leks, nesting and early brood-rearing habitat, and winter concentration areas inside Key Habitat Areas (Map 34) includes:

- CSU stipulation to prohibit or restrict surface-disturbing activities or surface occupancy within 0.6 mile of occupied or undetermined sage-grouse leks (125,843 acres)
- TLS stipulation to restrict disruptive activity within 0.6 mile of occupied or undetermined sage-grouse leks from 6 pm to 8 am from March 1 to May 15 (125,843 acres)
- TLS to prohibit or restrict surface-disturbing and/or disruptive activities in suitable sage-grouse nesting and early brood-rearing habitat within Key Habitat Areas from March 1 to June 30
- TLS to prohibit or restrict surface-disturbing and disruptive activities in mapped or modeled sage-grouse winter habitats/concentration areas that support Key Habitat Area populations from November 15 to March 14

Managing greater sage-grouse leks, nesting and early brood-rearing habitat, and winter concentration areas outside Key Habitat Areas (Map 34) includes:

- CSU stipulation to prohibit or restrict surface-disturbing activities or surface occupancy within ¼ mile of occupied or undetermined sage-grouse leks (5,802 acres)
- TLS stipulation to restrict disruptive activity within ¼ mile of occupied or undetermined sage-grouse leks from 6 pm to 8 am from March 1 to May 15 (5,802 acres)
- TLS to prohibit or restrict surface-disturbing and/or disruptive activities in suitable sage-grouse nesting and early brood-rearing habitat within mapped habitat important for connectivity or within 2 miles of any occupied or undetermined lek (945,670 acres)
- TLS to prohibit or restrict surface-disturbing and/or disruptive activities in mapped or modeled sage-grouse winter habitats/concentration areas from November 15 to March 14

These restrictions would impose moderate constraints to oil and gas development, resulting in adverse impacts. The impacts of these restrictions would vary across the Planning Area, depending on the projected development potential for oil and gas. For BLM-administered lands, management that constrains oil and gas development around greater sage-grouse leks, in nesting and early brood-rearing habitat, and in winter concentration areas in Key Habitat Areas would affect more acreage of moderate- and low-potential areas than alternatives A and C. However, outside Key Habitat Areas, Alternative D would likely impact oil and gas development potential lands similar to alternatives A and C.

Similar to Alternative B, Alternative D would limit noise sources at the perimeter of occupied greater sage-grouse leks; however, in contrast to Alternative B, Alternative D would only limit noise sources from 6 pm to 8 am. This would result in less adverse impact compared to Alternative B because noise restrictions would not limit daytime activities.

Restrictions on surface disturbance in raptor nesting areas under Alternative D would result in similar adverse impacts as those under Alternative A, although to a lesser extent due to smaller buffer areas. TLS and CSU restrictions around raptor nests, which vary by raptor species, would affect a total of 86,550 acres of BLM-administered surface. There would be restrictions in raptor nesting areas on approximately 9,700 acres of moderate oil and gas development potential lands, 40,866 acres of low-potential lands, and 31,842 acres of very-low-potential lands. As a result of specific stipulations for

ferruginous hawks, lands where greater sage-grouse and raptor habitats overlap could be subject to development restrictions for most of the year (9 months).

Alternative D would apply TLS restrictions in big game crucial winter range (1,313,731 acres) and big game parturition habitat (81,770 acres), resulting in similar impacts as Alternative A. However, Alternative D would exempt Oil and Gas Management areas (134,214 acres) from discretionary big game seasonal stipulations. This would allow development of oil and gas resources in these areas without these restrictions and would result in beneficial impacts to oil and gas development. Managing the Absaroka Front Management Area (130,895 acres) with a mix of CSU, TLS, NSO, and unavailable for leasing stipulations would prohibit oil and gas development or require lease stipulations that may increase project timeframes and costs. This would be an adverse impact to oil and gas development.

Under Alternative D, surface-disturbing activities are avoided within 500 feet and up to ¼ mile if needed to protect sensitive resources of the waters of the state, perennial surface water, and riparian/wetland areas. Avoiding surface-disturbing activities would prohibit the activity unless the impacts could be mitigated, thus increasing project timeframes and costs associated with mitigation or making oil and gas resources in these areas uneconomical to develop. This would be an adverse impact on oil and gas development.

The types of impacts to oil and gas development from VRM under Alternative D would be similar to those described for Alternative A, although the extent of these impacts would be greater because more area is managed as VRM Class I and Class II under this alternative. Of the areas available for oil and gas leasing, 524,682 acres are in VRM Class II areas, 831,317 acres are in VRM Class III areas, and 1,556,111 acres are in VRM Class IV areas. The nature and extent of impacts from VRM to oil and gas exploration and development would vary according to the development potential of the subject lands. Of the areas available for oil and gas leasing, VRM Class II areas include approximately 18,619 acres defined as having moderate oil and gas development potential. Approximately 79,315 acres are classified as low-potential lands and approximately 407,906 acres are classified as very-low-potential lands. Under Alternative D, VRM Class II areas in moderate development potential areas increase by approximately 32 percent compared to Alternative A.

Proactive Management

Alternative D designates Oil and Gas Management Areas on 134,214 acres of BLM-administered surface (433,950 acres less than under Alternative C) to be managed primarily for oil and gas exploration and development. Designating Oil and Gas Management Areas would result in similar, but less beneficial impacts, than Alternative C due to the reduced acreage under this alternative.

4.2.6 Leasable Minerals – Other Solid Leasable Minerals

No other solid leasable minerals are currently leased or produced in the Planning Area. Other solid leasable minerals in the Bighorn Basin are not currently considered economically viable to produce (BLM 2009c). Future demand for other solid leasable minerals will likely increase over time in parts of Wyoming and the U.S. West, but this is not anticipated to result in any new leasing or production in the Planning Area (BLM 2009c). See Section 4.2.2 *Leasable Minerals – Coal* and Section 4.2.3 *Leasable Minerals – Oil Shale* for information on these solid leasable minerals.

4.2.6.1 Analysis of Alternatives

The BLM reviewed leasing and development of other solid leasable minerals, such as tar sands, as part of this analysis. Alternatives A and C open known tar sand deposits/areas, including Sherard Dome and

Trapper Canyon, to mineral leasing. Under alternatives B and D, these areas would be administratively unavailable to leasing. However, the BLM does not anticipate new leasing or development of tar sands, or anticipates only minimal interest in these deposits, during the planning period. Therefore, the BLM anticipates only minimal adverse or beneficial impacts to the exploration or development of these resources under any alternative.

4.2.7 Salable Minerals

Implementing management actions under the alternatives may result in direct impacts that open, limit or deny access to and disposal of mineral materials from public lands in the Planning Area. Adverse impacts to mineral materials disposal can result from management actions that restrict or limit disposals of mineral materials, or that place specific stipulations or mitigation requirements on development activity. Beneficial impacts to mineral materials disposal can result from management that encourages such disposal or opens areas to disposal.

Indirect impacts result from actions that place or remove restrictions or place additional requirements on exploration and development activities for mineral materials. For example, a VRM restriction to protect the integrity of a historic trail that could either prevent or constrain exploration or development of mineral materials, or one that requires the development activity be performed so that it is not readily apparent.

Short-term impacts may include such seasonal restrictions to accessing mineral material resources to protect greater sage-grouse, or delays caused by requiring completion of resource surveys (such as cultural resources) before commencing mining operations. Long-term impacts may include transferring federal mineral estate, including the mineral materials therein, to private ownership, thereby potentially removing the resource from public access.

4.2.7.1 Methods and Assumptions

This analysis focuses on the impacts to mineral materials as a whole in the Planning Area. However, because sand and gravel are the principal salable minerals found in commercial quantities in the Planning Area, wherever possible, this analysis describes specific impacts to the disposal of sand and gravel. Acreages of occurrence potential of other mineral materials were not available at the time of analysis.

The BLM based this analysis on occurrence potential (referred to as "potential" in this analysis) for minerals identified in the *Solid Mineral Occurrence and Development Potential Report, Bighorn Basin Resource Management Plan Revision Project* (BLM 2009c). "Potential" refers to the potential for or the presence (occurrence) of a concentration of one or more mineral resources. It does not refer to or imply potential for development and/or extraction of the mineral resource(s). It does not imply that the potential concentration is or may be economic (i.e., could be extracted profitably). The mineral potential classification system is based on the level of potential and the level of certainty of data supporting the possible existence of minerals. The system classifies level of potential as No (O), Low (L), Moderate (M), High (H), and Not Determined (ND). The system classifies level of certainty as A (lowest certainty), B, C, and D (highest certainty). See *Glossary* or the *Solid Mineral Occurrence and Development Potential Report, Bighorn Basin Resource Management Plan Revision Project* (BLM 2009c) for more information on the mineral potential classification system.

Methods and assumptions used in this impact analysis include the following:

- Existing BLM-approved mineral material sites will remain open to mineral materials disposal.

- The potential for occurrence of mineral materials exists across the Planning Area.
- New mineral materials disposal sites in areas open to mineral materials disposal will be subject to site-specific analysis prior to approval.
- In most cases, demand for mineral materials during the planning period will be directly proportional to the rate of other resource development in a given area. New disposals could be requested to establish closer proximity to development areas, since generally, mineral materials are of low unit value compared to their cost to transport them from source to market.
- The BLM has discretionary authority to permit mineral materials disposal. It may choose to approve or disapprove such sales or permits, on a case-by-case basis, within the Planning Area.
- Common varieties of mineral materials are considered salable under the Materials Act of 1947. Uncommon varieties of such minerals may be locatable and subject to administration under the mining law, as amended.
- Area closures and surface and timing restrictions could result in adverse impacts by reducing access to mineral materials.
- Known sand and gravel deposits (Map 24), with a rating of high (H) and a certainty level of D, occur particularly along major drainages throughout the Planning Area and are depicted on Map 15 of the *Solid Mineral Occurrence and Development Potential Report, Bighorn Basin Resource Management Plan Revision Project* (BLM 2009c). There are about 882,618 acres of sand and gravel with known (high) occurrence potential in the Planning Area. Refer to the *Solid Mineral Occurrence and Development Potential Report, Bighorn Basin Resource Management Plan Revision Project* (BLM 2009c) for additional, detailed maps of mineral materials potential within the Planning Area.
- Sand and gravel deposits with an occurrence potential rating of moderate and certainty level of C (M/C) exist in small quantities on the western portion of the Planning Area. There are about 6,230 acres of sand and gravel with moderate occurrence potential in the Planning Area. The remainder of the Planning Area has a rating of low (L) with a certainty level of C (L/C).
- Sand and gravel deposits, which are likely to be developed, appear to be available in sufficient quantity and quality to sustain moderate to large increases in local and regional needs.
- Scoria (clinker) may be found associated with coalbeds which occur in the Mesaverde, Meeteetse, and Fort Union formations. Potential for the occurrence of scoria in the vicinity of these formations was rated as high (H) in the Gebo, Grass Creek, and Meeteetse coal fields with a certainty level of C (H/C).
- The potential for future commercial mining of scoria (clinker) from BLM-administered lands or mineral estate in the Planning Area is estimated to be moderate wherever these resources may be found and available.
- Known common-variety limestone within the Madison Formation has an occurrence potential of high (H) with certainty of D (H/D). Such occurrences are located along parts of the perimeter of the Planning Area. In the remainder of the Planning Area, the potential for limestone occurrence (not including limestone fragments found in colluvium, terrace, or alluvial deposits), is rated as low (L) with a certainty level of C (L/C).
- The development potential for continued and future commercial mining of common-variety limestone from federal mineral estate in the Planning Area is estimated to be moderate to high.
- The potential for the occurrence of common clay is rated as moderate (M) with a certainty level of C (M/C).

- The potential for future commercial mining of common clay from federal mineral estate in the Planning Area is estimated to be low to moderate.
- Throughout the Planning Area, there exists weathered rocks of sandstone, siltstone, limestone, or granite covered in part with lichens. Sandstones and siltstone outcrops in the Morrison, Cloverly, Mesaverde, Lance, and Fort Union formations are commonly considered to be moss rock if they are partially adorned with colorful lichens. In these formations, there is a high (H) potential for moss rock with a certainty level of D or C (H/D or H/C). Potential for moss rock occurrence in other parts of the Planning Area is rated as low (L) to moderate (M) with a certainty level of B (L/B to M/B).
- The potential for future commercial development of moss rock from federal mineral estate in the Planning Area is estimated to be high in areas where resources exist, and are available for disposal.
- In the Planning Area, flagstone is a mineral material that is typically found in the Chugwater, Cloverly, Sundance, Mesaverde, and Fort Union formations. In outcrops of the lowermost Sundance Formation, occurrence potential for flagstone is high (H) with a certainty level of C (H/C). Elsewhere in the Planning Area, the potential for flagstone is rated as low (L) to moderate (M) with a certainty level of C (L/C to M/C).
- The potential for future commercial development of flagstone from federal mineral estate in the Planning Area is estimated to be high in areas where flagstone resources exist, and are available for disposal.
- Potential for petrified wood to be found mixed in with Quaternary terrace or alluvial deposits, after having been transported from the Absaroka Mountains, is moderate (M) to high (H) with a certainty level of C (M/C to H/C).
- The potential for future commercial development of petrified wood from federal mineral estate in the Planning Area is estimated to be low.

4.2.7.2 Summary of Impacts by Alternative

Principle impacts to the development of mineral materials (e.g., sand and gravel) result from management that prohibits or limits (adverse impacts), or opens (beneficial impact) areas to mineral materials disposal. Such management commonly includes restrictions on surface-disturbing activities or closures to mineral materials disposal. Alternative B would result in the greatest adverse impacts to mineral materials, as this alternative closes 2,599,082 acres to mineral materials disposal, including areas within ¼ mile of riparian/wetland areas, Wild Lands (571,288 acres), and some ACECs (290,235 acres). Closures under alternatives C (348,215 acres), A (231,854 acres), and D (184,193 acres), respectively, would result in decreasing adverse impacts to mineral materials disposal.

4.2.7.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Restrictions on development of mineral materials may result in adverse impacts to exploration and development activities when either closures or prohibitions to surface-disturbing activities apply, because the mineral materials could not be accessed. The intensity of impacts is anticipated to vary by alternative. The more acreage closed or prohibited from surface disturbance, the more the adverse impacts to this development of mineral material resources. In addition, closing areas to mineral

materials with known or moderate potential would result in more adverse impacts than closing areas with no or low potential.

Management actions common to all alternatives that would adversely affect mineral materials disposal include closing cave and karst areas and WSAs to mineral materials disposal and prohibiting surface disturbance in the Bighorn River Habitat Management Plan (HMP)/Recreation Area Management Plan (RAMP) tracts and parts of the Yellowtail Wildlife Habitat Management Area. Discussions of individual alternatives describe adverse impacts from closures or prohibitions to surface disturbance.

Under all alternatives, new mineral materials disposal in areas open to mineral materials disposal are subject to site-specific analysis before approval. Approval of mineral materials disposal would require appropriate mitigation and site-specific reclamation fees based on a current mining and reclamation plan. The application of mitigation and a site-specific reclamation fee may prescribe certain activities or mitigation that could reduce the economic viability of mineral materials disposal and result in adverse indirect impacts to mineral materials disposal.

Prohibiting the disposal of topsoil in the Planning Area would result in impacts to mineral materials resources. Adverse impacts would result from the continued unavailability to disposal of this mineral materials resource via sale, permit, or free use to qualified entities.

Alternative A

Alternative A would close a total of 231,854 acres, 6 percent of federal mineral estate in the Planning Area, to mineral materials disposal. Closing these areas to mineral materials disposal would prohibit the development of mineral materials in these areas, if such deposits were present in a closed area. This may result in long-term adverse impacts to such disposals. Management that prohibits surface-disturbing activities and closes areas to the disposal of mineral materials would result in more adverse impacts in areas with known or moderate potential for the occurrence of mineral materials.

Disposal of sand and gravel would be closed on 18,078 acres, or 2 percent, of known occurrence areas, and on 1,091 acres, or 18 percent, of moderate potential areas in the Planning Area.

Resource Uses

Under Alternative A, surface-disturbing activities including mineral materials disposal would be prohibited to protect certain recreational uses, including fishing and hunting access areas (8,034 acres), Five Springs Falls Campground (40 acres), the Cody archery range (102 acres), and certain R&PP lease areas.

Surface-disturbing activities in The Rivers SRMA would be prohibited. Development of mineral materials may be allowed, on a case-by-case basis, in the following areas: Absaroka Foothills, Bighorn River, and West Slope SRMAs, and the Tour de Badlands, Tatman Mountain, Trapper Creek, Paint Rock, Brokenback/Logging Road, South Bighorns, Canyon Creek, Red Canyon Creek, McCullough Peaks, Horse Pasture, Beck Lake, and Newton Lake Ridge areas.

Special Designations

Closures/prohibitions of surface-disturbing activities resulting from special designations under Alternative A that would adversely affect mineral materials disposal include the fossil-concentration area in the Big Cedar Ridge ACEC (264 acres), Red Gulch Dinosaur Tracksite (1,798 acres) and WSAs (143,974 acres). Closures for segments of certain WSR eligible waterway segments comprise approximately 20,000 acres. This alternative also requires the avoidance of surface-disturbing activities in areas in view within ¼ mile of the Nez Perce (Neeme-poo) NHT and significant segments of Other

Trails, potentially placing additional stipulations or mitigation on development activity occurring in those areas.

Resources

Management actions for resources that restrict, prohibit, or limit mineral materials disposal would prevent development in these areas. This would result in adverse impacts to mineral materials disposal. Mineral materials disposal are prohibited within 500 feet of surface water and riparian/wetland areas, except where the activity can be mitigated. Mineral materials disposal may be restricted to protect important cultural sites on a case-by-case basis. In addition, on-the-ground surveys and monitoring of surface-disturbing activities in Potential Fossil Yield Classification (PFYC) 5 formations and, on a case-by-case basis, PFYC 4 formations, and prohibitions against resuming activities within 50 feet of a paleontological discovery until the BLM authorized officer so allows, may delay development of the resource or require the relocation of facilities.

Mineral materials disposal would be required to conform to the visual objectives that correspond to each area's VRM classification. Under Alternative A, approximately 480,315 acres, or 15 percent, of BLM-administered surface is designated as VRM Class I and II areas where changes to the characteristic landscape should be low. Adverse impacts may result where placement and design of facilities and pits associated with salable mineral mining activity would have to be redesigned, resulting in increased project costs. Where impacts could not be mitigated, these areas would be effectively closed to mineral materials disposal. The remainder of the Planning Area is classified as VRM Class III or IV, where activities would generally be allowed subject relatively reduced visual mitigation measures.

Alternative B

Closing public lands to mineral materials disposal would result in similar impacts as those described for Alternative A, although to a greater extent because more land would be closed. Alternative B would close or prohibit surface disturbance, therefore prohibiting mineral materials disposal on a total of 2,599,082 acres, or 62 percent, of federal mineral estate in the Planning Area. Alternative B represents the largest acreage of mineral material closures compared to the other alternatives.

Disposal of sand and gravel would be closed on 221,740 acres, or 25 percent of the areas where there is known occurrence of sand and gravel. About 2,180 acres, or 35 percent, of land with a moderate potential for occurrence of sand and gravel would be closed. The amount of area closed to sand and gravel disposal in known and moderate potential areas is greater under Alternative B than under any other alternative, which would result in more adverse impacts to mineral materials than the other alternatives.

Resource Uses

Under Alternative B, the BLM would prohibit surface-disturbing activities including mineral materials disposal to protect recreational uses, as described under Alternative A for fishing and hunting access areas, the Five Springs Falls campground, the Cody archery range, and certain R&PP lease areas. In addition, surface-disturbing activities are prohibited in the following recreation management areas: the Red Canyon Creek, the West Slope, Canyon Creek, McCullough Peaks, Horse Pasture, Beck Lake, Newton lake Ridge, and The Rivers SRMAs, as well as the Tour de Badlands, Tatman Mountain, Trapper Creek, Paint Rock, and Brokenback/Logging Road RMZs.

The Absaroka Foothills and Bighorn River SRMAs, and the Basin Gardens Play Area RMZ and Basin Gardens RMZ, are closed to the development of mineral materials under this alternative.

Special Designations

The management of special designations under Alternative B would result in a greater adverse impact on the disposal of mineral materials due to the severity of restrictions and the larger number of these areas in relation to the other alternatives. Specific closures/prohibitions of surface-disturbing activities resulting from special designations include the fossil-concentration area in the Big Cedar Ridge ACEC and the Brown/Howe Dinosaur Area, Carter Mountain, Five Springs Falls, Chapman Bench, Clarks Fork Basin/Polecat Bench, Clarks Fork Canyon, Foster Gulch Paleontological Area, McCullough Peaks South Paleontological Area, Rainbow Canyon, Rattlesnake Mountain, and Sheep Mountain ACECs, approximately 200,000 acres. Other closures/prohibitions include within 3 miles and in view within 5 miles of the Heart Mountain Relocation Center National Historic Landmark, the Nez Perce NHT, and Other Trails, as well as all land in WSAs (143,974 acres). Additionally, closures along segments of certain WSR suitable waterway segments comprise approximately 20,000 acres.

Under Alternative B, all LWCs would be designated as Wild Lands and would be closed to the disposal of mineral materials. Closures on these lands comprise 571,288 acres. Alternatives A, C, and D do not include specific management for mineral materials disposal in LWCs.

Resources

Management actions for resources that restrict, prohibit, or limit mineral materials disposal would prevent development in these areas. This would result in adverse impacts to mineral materials disposal. Under Alternative B, adverse impacts to mineral materials would generally be greater than under the other alternatives.

Disposal of mineral materials would be prohibited within ¼ mile of riparian/wetland areas, Class 1 or 2 waters (trout streams), certain rivers, big game crucial winter range (1,313,731 acres), parturition habitat (81,770 acres), and within ¼ mile of waters containing special status fish species.

Mineral materials disposal would be prohibited within 3 miles and in view within 5 miles of important cultural resources. Management to protect paleontological resources may have a greater effect under Alternative B than the other alternatives, because surveys and monitoring would be required for surface disturbance in PFYC 3, 4, and 5 formations, and permission from the authorized officer would be required to resume activities within 100 feet of a paleontological discovery.

VRM Class I and II areas under Alternative B would constitute 1,937,186 acres, or 61 percent, of BLM-administered surface. Impacts to mineral materials disposal would be similar to Alternative A, although to a greater extent because more acreage would be subject to increased VRM restrictions. Alternative B would result in the greatest impacts from constraints associated with VRM classifications.

Alternative C

Closing areas to mineral materials disposal would result in similar impacts as those described for Alternative A, although to a greater extent because more area is closed. Alternative C would close or prohibit surface disturbance on a total of 348,215 acres, or 8 percent, of federal mineral estate in the Planning Area to the disposal of mineral materials, more acreage than under alternatives A and D and less acreage than under Alternative B.

Disposal of sand and gravel would be closed on 36,861 acres, or 4 percent, of known occurrence areas, and closed on 663 acres, or 11 percent, of moderate potential area in the Planning Area. The acreage closed to sand and gravel disposal in known and moderate potential areas is more than under alternatives A and D, but less than under Alternative B.

Resource Uses

Managing resource uses under Alternative C would result in the least adverse impacts to mineral materials disposal compared to the other alternatives. Mineral materials operations in the following recreational use areas could be allowed on a case-by-case basis: fishing and hunting access areas, the Five Springs Falls campground, the Cody Archery Range, and certain R&PP lease areas.

Special Designations

Management of special designations under Alternative C would have the least adverse impact on the disposal of mineral materials in relation to the other alternatives. Specific mineral materials disposal closures under this alternative include within ¼ mile and in view within 1 mile of the Heart Mountain Relocation Center National Historic Landmark, the Nez Perce NHT, and Other Trails (with exceptions), as well as on lands in WSAs (142,031 acres). ACECs and other special designations would not adversely affect mineral materials under Alternative C, except in the Brown/Howe Dinosaur Area ACEC, where mitigation, paleontological sensitivity surveys, and monitoring are required for surface-disturbing activities.

Resources

Management actions for resources that restrict, prohibit, or limit mineral materials disposal would prevent development in these areas. This would result in adverse impacts to mineral materials disposal. Under Alternative C, adverse impacts to mineral materials disposal would generally be less than under the other alternatives.

Under Alternative C, mineral materials disposal would be allowed in floodplains or riparian/wetland areas on a case-by-case basis.

Areas within ¼ mile and in view within 1 mile of important cultural sites would be closed to disposal of mineral materials. Impacts from management to protect paleontological resources would be similar to Alternative A, except that potential delays due to surveying and monitoring of surface-disturbing activity would affect a smaller area because this management applies only in PFYC 5 areas.

VRM Class I and II areas under Alternative C would constitute 470,978 acres, or 15 percent, of BLM-administered surface. Impacts to mineral materials disposal would be similar to Alternative A, although to a lesser extent because less acreage would be subject to VRM Class I and II restrictions. Alternative C would result in the fewest impacts from constraints associated with VRM classifications.

Alternative D

Alternative D closes the least amount of land to mineral materials disposal, and therefore results in the least impacts to salable minerals compared to the other alternatives. Alternative D would close or prohibit surface disturbance, thereby excluding mineral materials disposal, on a total of 184,193 acres, or 4 percent, of federal mineral estate in the Planning Area, the least of all alternatives.

Alternative D would close 6,710 acres to disposal of sand and gravel, or less than 1 percent of the areas where there is known occurrence of sand and gravel and would not close any area with a moderate potential for occurrence of sand and gravel. The amount of area closed to sand and gravel disposal in known and moderate potential areas is the least of all alternatives, thereby resulting in the fewest adverse impacts.

Resource Uses

Under Alternative D, surface-disturbing activities are allowed, including salable minerals exploration and development, in recreational sites and trails on a case-by-case basis if the effects can be avoided or mitigated. While this would result in less of an impact than alternatives A and B, which prohibit surface-disturbing activities near recreation sites, an adverse impact would result from project delays and costs associated with mitigation. Similar impacts would result by requiring avoidance or mitigation for all surface-disturbing activities in the following areas: Absaroka Foothills SRMA; Bighorn River SRMA and ERMA; West Slope of the Bighorns SRMA (including Canyons RMZ and Brokenback/Logging Road RMZ); Middle Fork of the Powder River SRMA; Canyon Creek SRMA; campgrounds, trailheads, day use areas, river access sites, and similar recreation sites in The Rivers SRMA; Basin Gardens Play Area SRMA; and the Horse Pasture SRMA.

Development of mineral materials may be allowed, on a case-by-case basis, in the following areas: Absaroka Mountain Foothills SRMA, Absaroka ERMA, Beck Lake SRMA, Newton Lake Ridge SRMA, Basin Gardens area, and Tour de Badlands and Tatman Mountain RMZs.

Special Designations

Based on the types of restrictions and acreage affected, Alternative D would result in the second-greatest extent of adverse impacts on the disposal of mineral materials from special designations. Specific closures/prohibitions of surface-disturbing activities resulting from special designations include the fossil-concentration area in the Big Cedar Ridge ACEC and the Five Springs Falls, Clarks Fork Canyon, Paleocene-Eocene Thermal Maximum (PETM), and Sheep Mountain ACECs, for a total of 40,620 acres.

Alternative D also would prohibit mineral materials disposal within the 72 acres of the Heart Mountain Relocation Center National Historic Landmark Urban Center, while surface-disturbing activities would be avoided within 3 miles of the Nez Perce (Neeme-poo) NHT and up to 2 miles of other Historic Trails. Under Alternative D, WSAs would be closed to mineral materials disposal (143,974 acres).

Resources

While few management actions explicitly prohibit surface-disturbing activities or mineral materials disposal to protect other resources under Alternative D, several management actions require avoidance. Management actions that require avoidance would prohibit surface-disturbing activity unless the impacts can be mitigated, resulting in adverse impacts to mineral materials disposal through increased costs and delays associated with mitigation. Under Alternative D, some of the areas where surface-disturbing activity must be avoided include areas within 500 feet or up to ¼ mile if needed to protect waters of the state and riparian/wetland areas; within ¼ mile of any WGFD-rated Class 1 or 2 fisheries; and within big game crucial winter range from November 15 through April 30.

Alternative D prohibits mineral materials disposal for resource protection in the Chapman Bench Management Area (3,425 acres).

Surface-disturbing activities would be avoided under Alternative D to protect the foreground of important cultural resources up to 3 miles. This would increase costs associated with mitigation or prohibit disposal if the impacts cannot be mitigated, which would adversely affect the disposal of mineral materials. Impacts from management to protect paleontological resources would be similar to Alternative A, except that the monitoring of surface-disturbing activities would occur for PFYC 3, 4, and 5 formations on a case-by-case basis. Permission from the authorized officer would be required to resume activities within 100 feet of a paleontological discovery.

VRM Class I and II areas under Alternative D would constitute 779,883 acres, or 24 percent, of BLM-administered surface. Impacts to mineral materials disposal would be similar to Alternative A, although to a greater extent because more acreage would be subject to more stringent VRM restrictions.

4.3 Fire and Fuels Management

This section describes potential impacts on fire and fuels management from management of other resource programs. Implementation of the alternatives would affect the planning, management, implementation, and cost of fire management. Direct impacts involve restrictions on fire and fuels management. Indirect impacts include actions resulting in a change in risk or incidence of wildland fires; size, intensity, or destructive nature of wildland fires; fire suppression costs; and fuel loading. For example, mechanical treatments used to manage or reduce fuel loads result in indirect impacts by reducing the risk or incidence of wildland fire.

Fire is an integral part of natural ecosystem function; however, the natural fire regime largely has been suppressed in the Planning Area. Although the suppression of the natural fire regime is considered an adverse impact to fire ecology, actions contributing to an increase in the incidence of wildfires or limiting the ability to effectively fight wildfires are considered adverse impacts to fire management. This analysis focuses on the impacts to fire and fuels management. For example, actions limiting fire suppression tactics, thereby resulting in large burn areas or more intense fires, would be considered adverse impacts. Management that increases the ability to effectively and efficiently respond to and control wildfires and management that helps meet resource objectives are considered beneficial impacts.

Management restricting the acreage or effectiveness of prescribed fire would result in adverse impacts to fire and fuels management. Stipulations to protect other resources (e.g., wildlife, livestock grazing, historical, or cultural values) that limit or restrict prescribed burns in certain areas or at certain times of the year are considered direct adverse impacts to prescribed fire management. Management that increases the effectiveness and ability to conduct prescribed fires to meet resource objectives results in beneficial impacts.

For the purpose of this analysis, short-term impacts to fire and fuels management include impacts occurring within 5 years. Long-term impacts are those remaining or occurring after 5 years. The BLM anticipates short- and long-term impacts to fire and fuels management. Long-term impacts generally include impacts to the overall management of fire and fuels in the Planning Area. Short-term impacts to fire and fuels result from surface disturbance that increases the potential for the establishment of invasive species and other fuels.

The following description of impacts is organized into three sections: wildfires (unplanned ignitions), prescribed fires (planned ignitions), and stabilization and rehabilitation following fire. Methods and assumptions are described under the first section only, wildfires (unplanned ignitions), but apply to all three sections.

4.3.1 Wildfires (Unplanned Ignitions)

4.3.1.1 Methods and Assumptions

Wildland fire is a general term describing any non-structure fire that occurs in the vegetation and/or natural fuels, including both wildfires and prescribed fires. In addition to discussions of impacts specific to wildfire management, this section also discusses general impacts that could apply to both wildfire and prescribed fire management. These general impact discussions use the term wildland fire management to indicate that they apply to both wildfire and prescribed fire management; impact discussions specific to wildfire management use that term.

The analysis of impacts on fire and fuels management is based on the following assumptions, which apply to wildfires, prescribed fires, and stabilization/rehabilitation:

- Wildfires in wildland urban interface areas typically will be suppressed with unlimited tactics.
- The *Northern Zone Fire Management Plan* (BLM 2004a) implements the fire management direction on BLM-administered land within the Planning Area.
- Fire regime condition class (FRCC) inventories performed for the *Northern Zone Fire Management Plan* (BLM 2004a) are still accurate.
- Air quality currently is not affecting the ability to conduct prescribed burns; however, the more stringent air quality standards are, the more likely they will be to affect the ability to perform prescribed burns.
- Compared to limited tactics, unlimited tactics would reduce the amount of acres burned annually, but increase the amount of surface disturbance from suppression activities and result in the need for more rehabilitation of damage caused by suppression activities. Unlimited fire suppression tactics also alter the condition class of the vegetation by preventing wildfire to play its appropriate role in maintaining fire-adapted ecosystems.
- Nonnative species alter the risk of wildland fire. Current BLM policy is to ensure seeds used for rehabilitation are free of noxious weeds when reseeding is necessary.
- Annual bromes (e.g., cheatgrass) and invasive species can elevate the risk of fire and actually alter the natural fire regime; therefore, alternatives contributing to the invasion and spread of invasive species are anticipated to adversely affect fire and fuels management.
- In areas of cultural resource sensitivity, use of heavy equipment typically is limited to existing roads and trails, except where human safety is at risk.
- Cultural resource surveys are conducted, where applicable, for all prescribed burns, other fuel treatments, and rehabilitation.
- Current policy (BLM Manual 1745) requires use of native plant species for rehabilitation, except in certain situations (e.g., when native seeds are not available or resource management objectives cannot be met with native species).

4.3.1.2 Summary of Impacts by Alternative

All alternatives utilize wildland fire to restore fire-adapted ecosystems and reduce hazardous fuels. Alternative C would result in the greatest potential for adverse impacts from human caused, unplanned ignitions due to increased access and additional travel routes under this alternative. Conversely, Alternative C would also result in the greatest beneficial impacts from active fuels management (i.e., this alternative allows the widest use of fuels treatments) and the greatest ability to employ fire suppression tactics, followed by alternatives A, D, and B respectively. Alternative C includes the greatest amount of mechanical fuels treatments by acreage (60,000 acres), followed by alternatives A and D (30,000 acres each), and Alternative B (5,000 acres), resulting in beneficial impacts to fire and fuels management by reducing fuels and thereby the potential for fire spread and severity. Fire suppression restrictions (e.g., prohibiting the use of heavy equipment on fragile soils) increase the potential for wildfire spread in the short term and may increase the need for stabilization and rehabilitation as more wildfires occur. However, intensive fire suppression that reduces the natural role of fire in the ecosystem may result in large catastrophic wildfires in the long term that require more-intensive stabilization and rehabilitation activities. Under all of the alternatives, implementing the BLM Emergency Stabilization and Rehabilitation standards in the DOI *Interagency Burned Area Emergency Response Guidebook* (DOI

2006b) and *BLM Burned Area Emergency Stabilization and Rehabilitation Handbook* (BLM 2007b) would prescribe activities that would allow rehabilitation of areas following a wildfire and reduce the potential for future fires in burned areas.

4.3.1.3 Detailed Analysis of Alternatives

This section divides the analysis of impacts to fire and fuels management from the alternatives into three areas – impacts from restrictions from resources and special designations, impacts from resource uses, and impacts from proactive management actions. This analysis groups special designations with resources because the resource values within the special designations are the reason for management that would limit or restrict fire and fuels management techniques in these areas.

Impacts Common to All Alternatives

Restrictions from Resources and Special Designations

Although certain management of other resource programs and special designations may limit fire suppression tactics, in cases where human life or safety may be at risk, emergency fire suppression tactics would be used and would become a higher priority than any resource protection or management stipulations.

Avoiding the use of waters that contain high-risk aquatic invasive species for suppression activities (except in cases where public and firefighter safety are threatened) may limit fire suppression activities when other sources of water are unavailable or inadequate to meet fire suppression. This would adversely impact wildfire management.

Avoiding the aerial application of fire suppressant chemicals within 300 feet of perennial waters and restricting the use of fire retardant chemicals as appropriate to protect rock art and water quality would limit the potential to effectively control fires in these areas. This would adversely affect the management of wildland fires.

Suppressing fires that threaten greater sage-grouse habitats and crucial winter wildlife habitat within Wyoming big sagebrush communities and conducting fire management activities to minimize overall wildfire size and frequency in sagebrush plant communities where greater sage-grouse habitat objectives are at risk may create adverse impacts to fire ecology by affecting the natural fire regime in the ecosystem. Actions that suppress the natural role of fire in the ecosystem may result in fuels accumulation and eventually lead to larger and more intense fires. However, suppressing fires in these areas may also decrease the incidence of damaging wildfires to sagebrush habitat and greater sage-grouse and enhance the ability to manage fires in these areas. Establishing fuels treatments at strategic locations to minimize the size of wildfire and limit further loss of greater sage-grouse habitat would have long-term benefits to fire and fuels management by reducing the incidence and spread of wildfire in greater sage-grouse habitat.

Under all alternatives, constraints to protect and conserve habitat of special status species, especially the greater sage-grouse and other sagebrush obligate species would influence updating the Northern Zone Fire Management Plan (FMP) and managing consistent with the Northern Zone FMP. Standard operating procedures would influence the way wildfire suppression tactics may take place within habitat deemed important for special status species. If additional species become listed under the ESA, it is likely that the conservation measures developed to protect and restore such species would have long-term impacts on the types and timing of vegetation treatments allowable within their important habitats.

Prohibiting the use of bulldozers in areas of significant cultural resources or historic trails for fire suppression, unless an archeologist is present, may have adverse impacts on fire and fuels management by limiting the ability to effectively fight wildfires in these areas depending on availabilities and response times of archeologists. Assigning an archeologist to all fires with heavy equipment employed beyond minimum impact suppression techniques may delay fire suppression activities and adversely impact fire management.

Under all alternatives, management of vegetation and invasive species would result in long-term impacts to fire and fuels management. Under all alternatives, vegetation that does not meet DPC has the highest risk of losing important ecosystem components. Mechanical treatment in these areas may not be sufficient to diversify fuel conditions and reduce the potential for wildland fire occurrence or spread. Management actions that limit the potential for the spread or establishment of invasive species would generally have a beneficial impact to fire and fuels management. As invasive species dominate plant communities, fuels tend to build up in these areas. In general, invasive species and grasses, such as cheatgrass, are highly flammable and their presence can result in increased incidence and spread of fire. Long-term adverse impacts to fire and fuels management may result from annual increases in invasive species establishment and spread. Establishment and spread of invasive species would result in alterations of the fire behavior and fire ecology in the Planning Area, and may change the management response to fire.

Fire management in Wild Lands would be in accordance with the Northern Zone FMP, which would result in long-term impacts to fire and fuels management in these areas by providing guidance on fire management and fuels treatments.

Under all alternatives, management for wildland fire in special designations would create long-term impacts to fire and fuels management. Typically, areas that include special designations (e.g., ACECs or eligible WSRs) include management that prohibits the use of fire suppression techniques, such as the use of heavy equipment or fire retardant and chemicals, that would affect the resources and characteristics for which the area is designated.

Resource Uses

Allowing the sale of permits to meet public demand for personal use of posts, poles, firewood, sawlogs, Christmas trees, and other vegetative products may reduce fuel loading in those areas. The reduction in fuel loading would decrease the complexity of suppression operations and increase firefighter and public safety, but may also result in adverse impacts due to increased unplanned ignition sources (e.g., chainsaws) in woodlands.

Under all alternatives, land tenure adjustments may affect fire and fuels management due to ownership changes and the response to fire and fuels in lands managed by private or state owners. Isolated public land parcels within or near private lands may increase the complexity of BLM involvement in the suppression of wildfires and management of fuels, particularly in wildland urban interface areas. Land tenure adjustments that create larger blocks of public land by reducing inholdings would benefit BLM's fire and fuels management by decreasing such complexities.

The management of livestock grazing using the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N) would maintain enough fine fuels to allow for the use of wildland fire for resource benefit, where appropriate. In addition, adherence to these standards and guidelines would reduce the potential for conversion of healthy rangelands into invasive species (e.g., cheatgrass) dominated systems, which may reduce the frequency and spread of fires. Vegetation management actions to meet

the Wyoming Standards for Healthy Rangelands would also result in a diversity of age class, cover, and fuel loads in all plant communities that may reduce the size and intensity of wildfires in the long term.

Proactive Management

Under all alternatives, the response to wildland fire would be based on the ecological, social, and legal consequences of the potential action; the circumstances under which a fire occurs; the likely consequences to firefighter and public safety and welfare; natural and cultural resources; and values to be protected.

Maintaining and implementing the Northern Zone FMP to address fire management on a landscape scale and to meet DPC objectives and resource management objectives would result in long-term beneficial impacts to fire and fuels management. The Northern Zone FMP defines a program to manage wildland fires based on the RMP and provides for firefighter and public safety; fire management strategies, tactics, and alternatives; and addresses values to be protected consistent with management objectives, activities in the area, and federal, state, and local laws and regulations.

Cooperating with other agencies and landowners to conduct landscape level fuel treatments would have beneficial impacts on fire and fuels management by enhancing coordinated fuels management and restoring fire-adapted ecosystems.

Reducing hazardous fuels in the wildland urban interface would result in long-term beneficial impacts to fire and fuels management by limiting the incidence and spread of fires in these areas. Reducing the incidence and spread of fire in wildland urban interface areas would reduce the complexity of managing wildfires that cross ownership boundaries. Protecting homes and other structures from wildfires would result in long-term impacts to fire and fuels management by requiring fire suppression or fuels treatments in these areas.

Achieving a balance between treating areas that have departed from the historic fire regime (FRCC 3) and areas that are functioning within an appropriate fire regime (FRCC 1) would result in beneficial impacts on fire and fuels management. Treatment in FRCC 3 areas to return the fire ecology to the appropriate historic fire regime, along with stabilization and rehabilitation, would help decrease fuel loading in these areas and reduce the potential for future catastrophic fires in areas that have departed from their historic fire regime. Treating areas that are functioning within an appropriate fire regime (FRCC 1) would ensure that fire and fuels management maintains resource objectives within these areas. Balancing treatments in these areas would allow for an effective approach to managing fires based on FRCC and the appropriate fire regime and ecology in these areas. To varying degrees, vegetation treatments under all the alternatives would result in improvement in FRCC in the Planning Area and movement towards DPC for the treated areas.

Alternative A

Surface Disturbance

Surface disturbance results in adverse impacts to fire and fuels management by increasing the potential for invasive species establishment and spread in disturbed areas and, subsequently, the occurrence and severity of unplanned ignitions. Under Alternative A, the BLM projects a total of 136,415 acres of short-term surface disturbance on BLM-administered land during the life of the plan (Table 4-1). After reclamation, a total of 15,710 acres of long-term surface disturbance is projected under Alternative A (Table 4-1).

Restrictions from Resources and Special Designations

The management actions restricting fire suppression and fuels management discussed below would result in adverse impacts to wildfire management under Alternative A.

Reviewing the impacts of fire suppression to special status plant species on a case-by-case basis may limit fire suppression tactics in these areas, and thus may result in adverse impacts to fire and fuels management.

Prohibiting the use of heavy equipment for fire suppression in the Red Gulch Dinosaur Tracksite ACEC, the Carter Mountain ACEC, the Five Springs Falls ACEC, and the Little Mountain ACEC would result in adverse impacts to fire and fuels management by limiting the available techniques for fire suppression and mechanical treatment in these areas. Management objectives in special designations and SRMAs would help guide the response to wildland fire under Alternative A.

Prohibiting the use of chemical and dye retardants in the Red Gulch Dinosaur Tracksite ACEC would limit the available techniques for fire suppression in these areas, which may result in adverse impacts to fire and fuels management by limiting the ability to suppress wildfires in these areas.

Prohibiting the use of motorized and mechanized vehicles to suppress fires in certain WSR eligible waterway segments in the WFO, and prohibiting fire retardant along BLM-administered land within certain WSR eligible waterway segments would result in adverse impacts to fire and fuels management. Prohibiting the use of motorized vehicles to suppress fires may limit response times and efficiency of fighting wildfires in these areas and lead to increased wildfire severity and spread. Prohibiting fire retardant within certain WSR eligible waterway segments would result in adverse impacts by limiting fire suppression techniques in these areas.

Managing areas as VRM Classes I (141,110 acres) and II (339,205 acres) may limit the type or location of hazardous fuels reduction techniques when they alter the visual character of the landscape. Such restrictions may lead to an increase in fire size and spread in VRM Class I and II areas and adjacent areas. Fire and fuels management may benefit in VRM Class III and IV areas, where a wider range of hazardous fuel reduction techniques with the potential to alter the visual character of the landscape would be allowed.

Resource Uses

Mineral resources development may affect fire and fuels management by developing new facilities and associated infrastructure. Such development may change BLM's response to wildland fire due to increased human presence (i.e., workers) and the location of facilities in the Planning Area. Mineral exploration and development may also result in adverse impacts by increasing the potential for human caused fires in these areas.

Using wildland fire to revitalize decadent forest stands, improve forest stand density, and increase cover would result in beneficial impacts to fire and fuels management by helping reach DPC objectives and restoring areas to FRCC 1 and 2. Allowing a variety of silvicultural practices and cutting methods under Alternative A would have beneficial impacts on fire and fuels management by increasing the options available for fuels treatments. Managing forests and woodlands to meet forest and rangeland health standards would reduce hazardous fuel accumulations and reduce the potential for catastrophic wildfires.

The designation of utility corridors and authorization of ROWs may have beneficial impacts on fire and fuels management by removing or reducing built up fuels and by serving as fuel breaks and fire lines. Utility corridors and access road ROWs may also result in beneficial impacts by providing access for

firefighters and other fire and fuels management activities. Alternately, the designation of ROWs and increased human presence associated with the construction and use of ROWs may increase the potential for unplanned ignitions in the Planning Area.

Travel and transportation management would result in both adverse and beneficial impacts to the management of wildland fires. Travel designations that allow access may result in adverse impacts due to increased incidence of human caused fires. Allowing access to more remote locations may also increase the potential for fire in areas that are more difficult to respond to and where fires are subsequently more difficult control. Alternatively, travel routes may result in beneficial impacts by increasing access, response time, and flexibility in management when responding to fires.

Under Alternative A, management for recreation in the Planning Area would have long-term impacts to wildfires. Recreation use would result in the increased risk of human caused unplanned ignitions from campfires, vehicles, cook stoves, other recreation related activities. The risk of recreation-related wildfire would be highest around campgrounds, trailheads, and recreation management areas where recreational use is greatest.

Livestock grazing management would result in short-term and long-term impacts to fire and fuels management. Livestock grazing primarily affects the distribution, amount, height, and vigor of herbaceous species such as perennial grasses, which can determine fire characteristics. Livestock grazing can contribute to a reduction of fine fuels, which may reduce the spread of wildland fire. A decrease in fire spread may result in an increased accumulation of larger fuel sources such as shrub vegetation between fires, which may contribute to larger fires in the long term. Properly managed livestock grazing may also reduce flame length, fire line intensity, and rate of spread, which would have a beneficial impact on suppression activities. Fire line intensity and flame length are important measures of potential suppression success.

Proactive Management

Alternative A bases the response to wildland fire on ecological, social, and legal consequences; the circumstances under which a fire occurs; the likely consequences on firefighter and public safety and welfare; natural and cultural resources; and values to be protected.

Alternative A uses wildland fire to restore fire-adapted ecosystems and reduce hazardous fuels. This use of wildland fire would reduce the need for mechanical fuels treatment and the potential for large-scale fires in the long term, while also helping to meet resource objectives. This would result in beneficial impacts to fire and fuels management. Under Alternative A, the BLM projects approximately 30,000 acres of mechanical fuels treatment would occur during the life of the plan (Appendix T). Mechanical fuels treatments would result in beneficial impacts to fire and fuels management by reducing fuel buildup, the potential for fire spread, and fire severity.

Alternative B

Surface Disturbance

Adverse impacts to fire and fuels management from surface disturbance would be similar to those described under Alternative A, though to a lesser degree. Under Alternative B, the BLM projects a total of 73,919 acres of short-term surface disturbance on BLM-administered land during the life of the plan (Table 4-1). Implementing Alternative B would result in a 46-percent decrease in short-term surface disturbance on BLM-administered land compared to Alternative A, a 70-percent decrease compared to Alternative C, and a 47-percent decrease compared to Alternative D. After reclamation, the BLM projects a total of 10,882 acres of long-term surface disturbance under Alternative B (Table 4-1).

Implementation of Alternative B would result in a 31-percent decrease in long-term surface disturbance on BLM-administered land compared to Alternative A, a 74-percent decrease compared to Alternative C, and a 41-percent decrease compared to Alternative D.

Restrictions from Resources and Special Designations

Management actions restricting fire suppression, fuels management, or wildland fire planning would result in adverse impacts to wildland fire management. In general, restrictions on fire management for the protection of resource objectives are greater under Alternative B than under the other alternatives.

Alternative B includes similar fire suppression and heavy equipment restrictions as Alternative A, with several exceptions. Alternative B prohibits fire suppression and the use of chemicals within ¼ mile of any known special status plant species population. In addition, restrictions on motorized vehicles to suppress fires and restrictions on the use of fire retardants apply to all WSR suitable waterway segments. Alternative B includes more special designations and recreation management areas, which would restrict the response to wildfire in these areas to protect the resource characteristics for which the areas were designated.

Adverse impacts to fire and fuels management from VRM allocations would be similar to those described under Alternative A, though to a greater extent due to more area allocated as VRM Class I and II under Alternative B.

Resource Uses

Under Alternative B, management actions for minerals would have similar impacts as those described under Alternative A, though to a lesser degree due to decreased minerals development under Alternative B.

Using natural processes to revitalize decadent forest stands, improve forest stand density, and increase canopy cover would result in short-term adverse impacts on fire and fuels management by limiting the use of some wildland fire as a fuels management technique. However, using natural processes for fuels management may result in long-term beneficial impacts by returning fire to its natural role in the ecosystem.

Identifying specific disposal and acquisition zones may increase the potential for land tenure adjustments that consolidate land ownership and reduce scattered and isolated parcels. This may result in beneficial impacts to fire and fuels management of wildland fires by reducing complexities associated with managing fire and fuels in mixed ownership areas.

Impacts to fire and fuels management from the utility corridors designated under Alternative B would be similar to those under Alternative A, though to a lesser degree as less acreage is designated as ROW corridors. Managing more acreage as ROW avoidance/mitigation and exclusion areas would reduce the prevalence of fuel breaks and fire lines but would also decrease human presence and the potential for unplanned ignitions.

The beneficial and adverse impacts to fire and fuels management from travel and transportation management under Alternative B would be similar to those described under Alternative A, though to a lesser degree due to increased restrictions and less area available for motorized travel.

Management for recreation would have similar impacts to fire and fuels management described under Alternative A, though to a greater degree. Alternative B includes fewer upgrades to sites already developed for recreational use, but the increased area managed as SRMAs—and associated new development—may increase the potential for unplanned ignitions in these areas due to increased recreation activity.

The types of impacts on fire and fuels management from livestock grazing would be similar to those described for Alternative A. However, all these impacts would occur to a much lesser degree because a larger area is closed to livestock grazing under this alternative (1,988,927 acres versus 5,172 acres under Alternative A).

Proactive Management

Under Alternative B, response to wildland fires may vary from full suppression in areas where fire is undesirable, to monitoring fire behavior in areas where fire can be used as a management tool, based on resource goals and objectives. Alternative B utilizes wildland fires and other treatments to restore fire-adapted ecosystems and to reduce hazardous fuels. Mechanical fuels treatments would be similar to those described under Alternative A, though to a lesser degree since only 5,000 acres are projected for mechanical fuels treatments under Alternative B (an approximately 83 percent decrease from Alternative A) (Appendix T). Mechanical fuels treatment under Alternative B would result in fewer beneficial impacts than under the other alternatives.

Although the use of fire suppression under Alternative B is more restricted than under Alternative A, the BLM anticipates that proactive management to employ wildland fire to achieve management objectives and to restore fire-adapted ecosystems would result in long-term beneficial impacts to fire and fuels management throughout the Planning Area. Under Alternative B, the emphasis on restoring the natural role of fire in the ecosystem may result in adverse impacts in the short term as reduced mechanical fuel treatments may result in an increased incidence of fire. In the long term, it is unlikely that beneficial impacts to fire and fuels would result due to historic fire suppression activities, changes to fuel loading, and human occupancy and use of the Planning Area. Long-term restoration of natural conditions is less likely than under Alternative A. The greater restrictions on mechanical fuels treatments and suppression under Alternative B would result in greater potential adverse impacts to private lands as unplanned ignitions, and subsequent wildfires that may spread to private lands, are most likely under this alternative.

Alternative C

Surface Disturbance

Impacts to fire and fuels management from surface disturbance would result in similar impacts as those described under Alternative A, though to a greater degree. Under Alternative C, the BLM projects a total of 245,783 acres of short-term surface disturbance on BLM-administered land during the life of the plan (Table 4-1). Implementing Alternative C would result in an 80-percent increase in short-term surface disturbance on BLM-administered land compared to Alternative A, a 233-percent increase compared to Alternative B, and a 75-percent increase compared to Alternative D. After reclamation, a total of 41,545 acres of long-term surface disturbance is projected under Alternative C (Table 4-1). Implementing Alternative C would result in a 164-percent increase in long-term surface disturbance on BLM-administered land compared to Alternative A, a 282-percent increase compared to Alternative B, and a 125-percent increase compared to Alternative D.

Restrictions from Resources and Special Designations

Management actions restricting fire suppression, fuels management, or wildland fire planning would result in adverse impacts to wildland fire management. In general, Alternative C contains the fewest restrictions on fire management for the protection of other resource objectives.

Fire suppression impacts due to special status plant are the same as under Alternative A.

Besides the restrictions and impacts described under Impacts Common to All Alternatives, Alternative C includes no other specific restrictions on fire and fuels management related to resource objectives or special designations. Alternative C would allow for the highest level of fire suppression compared to the other alternatives.

Impacts to fire and fuels from VRM allocations would be similar to those described under Alternative A, though to a slightly area managed as VRM Class I and II.

Resource Uses

Management for minerals would result in impacts similar to those described under Alternative A, though to a greater extent due to more minerals development under Alternative C.

Using logging and timbering instead of wildland fire and other natural processes to revitalize decadent forest stands, improve forest stand density, and increase canopy cover would result in long-term adverse impacts on fire and fuels management by limiting the natural role of wildland fire in ecosystems. However, logging and timbering would result in short-term beneficial impacts by reducing fuel loads and the possibility of catastrophic fires.

Identifying specific disposal and acquisition zones would result in similar impacts as those described under Alternative B.

Impacts to fire and fuels management from the utility corridors designated under Alternative C would be similar to those under Alternative A, but to a lesser degree because the BLM designates fewer corridors under this alternative, though more than alternatives B and D. ROW avoidance/mitigation or exclusion acreage under Alternative C would result in similar impacts to those under Alternative A, but to a greater degree.

Impacts to fire and fuels management from travel and transportation management under Alternative C would be similar to those described under Alternative A, though to a greater degree. Alternative C has fewer areas closed to travel and more area open to cross-country motorized travel compared to other alternatives.

Under Alternative C, impacts to fire and fuels management from recreation would be similar to those described under Alternative A, though to a greater degree due to an increase in the development of recreation sites and facilities. Alternative C manages fewer areas as SRMAs compared to the other alternatives. However, based on projected surface disturbance (Appendix T) Alternative C would lead to the development of the most recreation sites and the largest increase in the potential for unplanned ignitions in these areas.

Management for livestock grazing would result in impacts similar to those described for Alternative A.

Proactive Management

Under Alternative C, the response to wildfire would be the same as that described for Alternative B.

Under Alternative C, the BLM would use wildland fire to restore fire-adapted ecosystems for commodity production and to reduce hazardous fuels. Alternative C places more emphasis on fire and fuels management for the use of resources compared to Alternative B, which utilizes wildland fire to restore the natural processes of ecosystems.

Impacts from mechanical fuels treatments would be similar to those described for Alternative A, although to a greater degree because 60,000 acres are projected for mechanical fuels treatments under Alternative C (a 100-percent increase compared to Alternative A) (Appendix T). The use of mechanical fuels treatment under Alternative C would be greater than under alternatives A, B, and D.

Alternative D

Surface Disturbance

Impacts to fire and fuels management from surface disturbance would result in similar impacts as those described under Alternative A, though to a greater degree. Under Alternative D, a total of 140,508 acres of short-term surface disturbance is projected on BLM-administered land during the life of the plan (Table 4-1). Implementing Alternative D would result in a 3-percent increase in short-term surface disturbance on BLM-administered land compared to Alternative A, a 90-percent increase compared to Alternative B, and a 43-percent decrease compared to Alternative C. After reclamation, a total of 18,443 acres of long-term surface disturbance is projected under Alternative D (Table 4-1). Implementing Alternative D would result in a 17-percent increase in long-term surface disturbance on BLM-administered land compared to Alternative A, a 69-percent increase compared to Alternative B, and a 56-percent decrease compared to Alternative C.

Restrictions from Resources and Special Designations

Management actions restricting fire suppression, fuels management, or wildland fire planning would result in adverse impacts to fire and fuels management. In general, restrictions on fire management for the protection of other resource objectives under Alternative D are greater than under alternatives A and C, but less than under Alternative B.

Allowing the application of fire suppression chemicals within ¼ mile of known or documented populations of BLM special status plant species with the consent of the authorized officer would result in the least adverse impact to the use of suppression tactics of any alternative.

Special designations under Alternative D would result in similar adverse impacts to fire and fuels management as those under Alternative A, but to a greater degree. In addition to the ACECs restricting fire suppression tactics that are similarly designated under Alternative A, the BLM restricts the use of heavy equipment during fire suppression operations over important caves and cave passages in the Craig Thomas Little Mountain Special Management Area (SMA). Unlike alternatives A and B, Alternative D does include WSR eligible or suitable waterway segments that would restrict the use of fire suppression techniques along these waterways.

Impacts from allocation of VRM Class I and II areas would be similar to those described under Alternative A. Due to the area allocated as VRM Class I and II, adverse impacts to fire and fuels management from VRM allocations would be greater than those under alternatives A and C, but less than those under Alternative B.

Resource Uses

Under Alternative D, mineral resource exploration and development would have similar impacts to those under Alternative A, though to a lesser degree due to decreased minerals development projected under Alternative D. Adverse impacts from management of mineral resources under Alternative D would be greater than Alternative B, but less than Alternative C.

Forests, woodlands, and forest products management under Alternative D would result in similar impacts to those under Alternative A.

Identifying specific disposal and acquisition zones would result in similar impacts as those described under Alternative B.

Impacts to fire and fuels management from the designation of utility corridors under Alternative D would be similar to those described under Alternative A, though to an extent similar to Alternative C as a

similar acreage is designated for ROW corridors. Alternative D manages more acreage as ROW avoidance/mitigation or exclusion areas than alternatives A and C, but less than Alternative B, with proportional impacts.

Impacts to fire and fuels management from travel and transportation management under Alternative D would be similar to those described under Alternative A, fewer than under Alternative C, and greater than under Alternative B.

The impacts to fire and fuels management from recreation would be similar to those under Alternative A, but to a greater degree. Management of SRMAs under Alternative D would result in similar impacts to those under Alternative B, but to a lesser degree.

Livestock grazing management under Alternative D would result in similar impacts to fire and fuels management as those under Alternative A. Emphasizing livestock grazing as a tool to improve resource conditions may result in beneficial impacts if grazing reduces fine fuels in certain areas (Diamond et al. 2009).

Proactive Management

Under Alternative D, the response to wildland fire would be the same as described under Alternative B. Fire and fuels management would result in similar impacts, in degree and extent, as those described under Alternative A. Under Alternative D, emphasizing the use of wildland fires and other vegetation treatments to accomplish resource management objectives may result in additional beneficial impacts to fire and fuels management.

4.3.2 Prescribed Fires (Planned Ignitions)

Prescribed fires can be implemented as a tool to meet resource objectives, such as for wildlife habitat enhancement, forage production, and fuel reduction.

Impacts described above in Section 4.3.1 *Wildfire* for wildland fires would apply to prescribed fires. Prescribed fires, a type of wildland fire, include any fire intentionally ignited by management under an approved plan to meet specific objectives. Restrictions on fire management techniques and equipment would apply to the management and control of prescribed fires. This section describes only impacts specific to managing prescribed fires. Prescribed fire that has exceeded, or is expected to exceed, prescription parameters or otherwise meets the criteria for conversion to wildfire is considered an escaped prescribed fire. This may occur when a prescribed fire burns out of control or moves outside established fire lines due to wind or other factors; under these circumstances, the escaped prescribed fire is classified as a wildfire.

Direct impacts to prescribed fire include restrictions or stipulations from other resources prohibiting or limiting prescribed fires in certain areas or at certain times of the year. Prescribed fire can result in short-term adverse impacts associated with the actual fire event. However, prescribed fire reduces fuel loads and the potential for larger-scale catastrophic fires and aids in the achievement of vegetation and resource objectives. This typically results in long-term beneficial impacts to resources and ecosystems.

4.3.2.1 Methods and Assumptions

Section 4.3.1 *Wildfire* describes methods and assumptions used in the analysis of impacts to fire and fuels management (including prescribed fire). This analysis focuses on impacts to the management of prescribed fires.

4.3.2.2 Summary of Impacts by Alternative

The use of prescribed fire to achieve measurable objectives and to reduce fuel loading would result in beneficial impacts to fire and fuels management. Conversely, restricting the use of prescribed fire would result in primarily adverse impacts to fire and fuels management, such as the ability to reduce fuel loads. Limiting the use of prescribed fire may affect the ability of the fire and fuels program to meet fire management goals. Alternative B would restrict the use of prescribed fire the most, followed by alternatives D, A, and C respectively. Alternative C would result in the greatest beneficial impacts to fire and fuels management compared to the other alternatives. Alternative C would impose the fewest restrictions on the use of prescribed fire, resulting in the application of prescribed fire on a projected 80,000 acres over the life of the plan, twice as many acres of disturbance as alternatives A and D, and four times as many as Alternative B. Alternative D also emphasizes the use of prescribed fire to meet resource management objectives, but applies greater restrictions on its use compared to Alternative C.

4.3.2.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Managing prescribed fires to comply with Wyoming DEQ air quality standards and smoke management rules may result in adverse impacts to the management of prescribed fires by limiting the scale and extent of prescribed fires necessary to achieve fuel reduction targets and other resource objectives.

All alternatives bring forward the District FMP. Maintaining and implementing this FMP, the Northern Zone FMP, consistent with this RMP to address fire management on a landscape scale and to meet DPC objectives and resource management objectives would result in long-term impacts to the management of prescribed fire.

In order to implement and document a prescribed fire, NEPA compliance requires an interdisciplinary team to conduct site-specific analysis, including ESA and NHPA consultation. In accordance with current BLM Prescribed Fire Management Guidelines (H-9214), a Prescribed Fire Plan is required for prescribed fires. The Prescribed Fire Plan is a site-specific implementation document containing specific resource objectives, prescription criteria, and provisions for suppression if the fire escapes. The presence of resources identified during surveys (e.g., cultural sites, sensitive species habitat) would determine the parameters of prescribed fires in these areas and may prohibit prescribed fire or require specific mitigation or BMPs to ensure prescribed fire is implemented consistent with resource objectives. Additional restrictions on surface-disturbing activities (which include mechanical fuels treatments and prescribed fires) for the protection of resource values identified in the alternatives would further limit the use of prescribed fire in certain areas.

The use of prescribed fire would result in long-term beneficial impacts to fire and fuels management by moving areas towards DPC, reducing fuel loading, and reducing the potential for future catastrophic fires. However, through the removal of existing vegetation and exposure of soil, prescribed fire may increase the potential for the establishment and spread of invasive species (such as cheatgrass) which may increase the incidence and spread of fire.

Taking into account invasive herbaceous species, Fire Regime Groups, and FRCCs when considering treatments, including prescribed fire, would result in beneficial impacts to fire and fuels management. Planning prescribed fires in consideration of invasive species may limit the potential for invasive species establishment and spread, which may decrease the potential for fire incidence and spread and reduce the potential for future prescribed fire or other treatments. Implementing prescribed fires based on

FRCC would concentrate prescribed fire activity in areas that would benefit from treatments, and may help return areas to their historic fire regimes.

Designing prescribed fire treatments to protect and improve greater sage-grouse habitat would encourage the design and implementation of prescribed fires to meet resource objectives for greater sage-grouse. This would result in beneficial impacts to fire and fuels management.

Under current BLM policy, areas where prescribed burns occur are generally deferred from livestock grazing for at least two consecutive growing seasons, based on management objectives consistent with the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N). The BLM may adjust the two-growing-seasons deferment requirement based on environmental conditions and management objectives. Prescribed burns generally are not possible where domestic livestock producers are unable to absorb the cost of the deferral period. This policy may restrict the ability to use prescribed fire as a management tool in certain areas. This may adversely affect the management of prescribed fire. Wild horses in HMAs also could adversely affect burned areas.

Alternative A

Surface Disturbance

Surface disturbance can result in the establishment of invasive species, which increases the potential for fire occurrence and spread. In areas where invasive species become established or spread after surface disturbance, the BLM may use prescribed fire as a management tool to reduce these fuels. Section 4.3.1 *Wildfire* describes total surface-disturbance acreages and compares alternatives.

Implementation of Alternative A is projected to result in 40,000 acres of short-term surface disturbance on BLM-administered land from prescribed fire. No long-term surface disturbance is projected (Appendix T).

Restrictions from Resources and Special Designations

Closing all BLM-administered land in WSR eligible waterway segments to vegetative treatments (including prescribed fire) would result in adverse impacts to fire and fuels management. Prohibiting prescribed fire in these areas would limit the tools available to manage hazardous fuels in these areas, which may increase the potential for larger-scale fires.

Restrictions on heavy equipment and fire suppression activities identified for wildland fire under Section 4.3.1 *Wildfire* would apply to prescribed fires in WSR eligible waterway segments. These restrictions would require other techniques for the control of prescribed fires, if the BLM implemented prescribed fires in these areas.

Management that prohibits or limits surface-disturbing activities for the protection of resources values would result in adverse impacts to fire and fuels management by prohibiting or limiting prescribed fires in these areas. Restrictions on prescribed fires (and other mechanical fuels treatments) may result in the accumulations of fuels and the potential for large-scale catastrophic fires in these areas, which may result in greater adverse impacts in the long term to the resource values for which restrictions are applied. Restrictions for the protection of resources that would limit or prohibit prescribed fire under Alternative A such as prohibiting surface-disturbing activities within 500 feet of surface water, TLS in big game crucial winter ranges, and CSU restrictions within ¼ mile of occupied greater sage-grouse leks would result in adverse impacts.

Resource Uses

Management of ROWs and minerals that increases the amount of roads and the linear clearing of vegetation may result in beneficial impacts to prescribed fire. These linear clearings can serve as fire breaks or fire lines for the control of prescribed fire and reduce the need to clear additional vegetation for the control of prescribed fire.

Proactive Management

Under Alternative A, and in accordance with the Northern Zone FMP, the BLM would use prescribed fire to meet other resource management objectives (e.g., wildlife habitat or range condition) and to reduce hazardous fuels. The BLM would implement prescribed burns on 150 to 500 acres of BLM-administered land per year (totaling approximately 40,000 acres), based on the potential for initial burns, and then as needed to maintain historic vegetation and disturbance regimes.

As described in the Northern Zone FMP, the BLM would perform baseline and post-treatment monitoring following prescribed fire. Post-treatment monitoring is required to determine the accomplishment of direct treatment objectives and resource management objectives. Direct treatment objectives usually are attributes such as plant mortality, fuel consumption, burn pattern (mosaic), and total acreage. Resource management objectives usually concern post-treatment vegetation attributes such as cover, frequency, production, density, and stocking level of a desired species (see BLM Handbook H-9214).

Implementation of the Northern Zone FMP would result in long-term impacts to fire and fuels management by requiring the following activities following a prescribed fire:

- Pre and post Fire Regime and Condition Class evaluation
- At least one photo point location, which can be returned to, preferably taken in four opposing directions both pre- and post-treatment
- A North Zone Fuels Treatment Monitoring Form completed and filed in the Range Improvement Projects project file
- A geographic information system (GIS) database that includes a completed attribute table and pre- and post-treatment shape files of the treatment perimeter

In addition, the BLM will evaluate a representative number and type of treatments to document the effectiveness of modifying fire behavior. For example, the zone fuels specialist may calculate pre- and post-treatment fire behavior for at least each fuel model treated in the zone.

These activities would provide appropriate evaluation and documentation of prescribed fire activities, which may increase the efficiency and effectiveness of future prescribed fire activities to meet resource objectives and reduce fuel loading.

Alternative B

Surface Disturbance

Surface disturbance may result in the establishment of invasive species, which increases the potential for fire occurrence and spread. In areas where invasive species become established or spread after surface disturbance, the BLM may use prescribed fire as a management tool to reduce these fuels. Section 4.3.1 *Wildfire* describes total surface-disturbance acreages and compares alternatives.

Implementing Alternative B is projected to result in 20,000 acres of short-term surface disturbance on BLM-administered land from prescribed fires (Appendix T). Short-term surface disturbance from prescribed fire would be less than under the other alternatives. No long-term disturbance is projected.

Restrictions from Resources and Special Designations

Restrictions that limit or prohibit prescribed fire for the protection of resource values would result in similar impacts to those described under Alternative A, though to a greater degree. In general, management under Alternative B focuses on the protection and conservation of resources and resource values. Under Alternative B, restrictions on surface-disturbing activities for the protection of resources that would limit or prohibit prescribed fire would be greater than under alternatives A and C.

Under Alternative B, the BLM seasonally stipulates fuels treatments (including prescribed fire) in the Chapman Bench, Clarks Fork Canyon, Rattlesnake Mountain, and Sheep Mountain ACECs, as well as the Absaroka Front Management Area. Seasonal stipulations may adversely affect fire and fuels management by limiting prescribed fire as a tool for fuels reduction in these areas.

Closing all WSR suitable waterway segments to prescribed fire would result in the same impacts as those described under Alternative A.

Restrictions on heavy equipment and fire suppression activities identified for wildland fire under Section 4.3.1 *Wildfire* would apply to prescribed fires in WSR suitable waterway segments. These restrictions would require other techniques for the control of prescribed fires, if the BLM implements prescribed fires in these areas.

Alternative B also prohibits surface-disturbing activities within ¼ mile of, or within riparian/wetland areas, which would limit the use of mechanical vegetation treatments and prescribed fire necessary to restore ecosystem health in some kinds of riparian systems. This would result in a greater impact than Alternative A which limits surface-disturbing activity within 500 feet of riparian/wetland areas.

Alternative B includes the greatest amount of special designations where management is prescribed for the protection of resource values. As a result, prescribed fire and other fuels treatments are decreased in these areas more than under the other alternatives.

The restrictions on prescribed fire use under Alternative B would likely result in greater adverse impacts to private lands, as the potential for wildfires starting in heavily fuel-laden areas spreading onto private lands would be greater under Alternative B, compared to the other alternatives.

Resource Uses

Impacts to prescribed fire from management for ROWs and minerals would result in similar impacts as those described under Alternative A, though to a lesser degree due to decreased mineral activity and more acreage managed as ROW avoidance/mitigation or exclusion areas. Designating less area for utility corridors than Alternative A would result in similar beneficial impacts, but to a lesser degree.

Proactive Management

Under Alternative B, the BLM would use prescribed fire and other vegetative treatments to restore fire-adapted ecosystems for natural resource systems and to reduce hazardous fuels. Prescribed fire would reduce fuels and the potential for future large-scale catastrophic fires. This would result in beneficial impacts to fire and fuels management. Under Alternative B, the BLM would use habitat enhancement treatments (including prescribed fire) in sagebrush communities on at least 200 acres of BLM-administered land per year; prescribed fire would occur on a total of approximately 20,000 acres over the life of the plan.

Management identified in the Northern Zone FMP for prescribed fire monitoring may be carried forward under Alternative B, consistent with management under this alternative. Impacts would be the same as those described for Alternative A.

Alternative C

Surface Disturbance

Surface disturbance may result in the establishment of invasive species, which increases the potential for fire occurrence and spread. In areas where invasive species become established or spread after surface disturbance, the BLM may use prescribed fire as a management tool to reduce these fuels. Section 4.3.1 *Wildfire* describes total surface-disturbance acreages and compares alternatives.

Implementing Alternative C is projected to result in 80,000 acres of short-term surface disturbance on BLM-administered land from prescribed fires (Appendix T). Short-term surface disturbance from prescribed fires would be greater than under alternatives A, B, and D. No long-term surface disturbance is projected.

Restrictions from Resources and Special Designations

Seasonally stipulating fuels treatments in the Absaroka Front Management Area would result in the same impacts as those described under Alternative B.

Restrictions that limit or prohibit prescribed fire for the protection of resource values would result in similar impacts to those described under Alternative A, though to a lesser degree. In general, Alternative C reduces restrictions for the protection of resources, allowing greater use of prescribed fire compared to the other alternatives.

Resource Uses

Impacts to prescribed fire from minerals development under Alternative C would result in similar impacts as those described under Alternative A, though to a greater degree. Alternative C is projected to result in the greatest amount of oil and gas development, and the amount of roads would increase proportionally. Alternative C designates the second-largest area for utility corridors, which would result in proportional beneficial impacts to prescribed fire. Impacts from ROW management would result in similar impacts to those under Alternative A, although to a lesser degree because the BLM would manage more acreage as ROW avoidance/mitigation or exclusion areas.

Proactive Management

Utilizing prescribed fire to restore fire-adapted ecosystems would result in the same impacts as those described under Alternative B. Under Alternative C, the BLM would implement prescribed fire and other treatments in sagebrush communities as opportunities and funding allow; prescribed fire would occur on approximately 80,000 acres.

Management identified in the Northern Zone FMP for prescribed fire monitoring may be carried forward under Alternative C, consistent with management under this alternative. Impacts would be the same as those described for Alternative A.

Alternative D

Surface Disturbance

Surface disturbance may result in the establishment of invasive species, which increases the potential for fire occurrence and spread. In areas where invasive species become established or spread after

surface disturbance, the BLM may use prescribed fire as a management tool to reduce these fuels. Section 4.3.1 *Wildfire* describes total surface-disturbance acreages and compares alternatives.

Implementing Alternative D is projected to result in the same acreage as Alternative A of short- and long-term surface disturbance on BLM-administered land from prescribed fire.

Restrictions from Resources and Special Designations

Restrictions that limit or prohibit prescribed fire for the protection of resource values would result in similar impacts as those described under Alternative A, though to a greater degree. Under Alternative D, restrictions on surface-disturbing activities for the protection of resources that would limit or prohibit prescribed fire would be greater than under alternatives A and C, but less than under Alternative B.

Seasonal stipulations on fuels treatments under Alternative D would result in similar adverse impacts to fire and fuels management as those under Alternative B in the Absaroka Front Management Area, but to a lesser degree overall as it designates fewer ACECs with seasonal stipulations.

Restrictions on heavy equipment and fire suppression activities identified for wildland fire in Section 4.3.1 *Wildfire* would also apply to prescribed fires. These restrictions would require other techniques for the control of prescribed fires, if the BLM implemented prescribed fires in these areas.

Alternative D also avoids surface-disturbing activities within 500 feet, or ¼ mile of sensitive habitat, of waters of the state, perennial surface water, and riparian/wetland areas, which would result in impacts similar to those described for Alternative B, but to a lesser degree. This would result in a greater impact than Alternative A, which limits surface-disturbing activity within 500 feet of riparian/wetland areas.

Management of special designations under Alternative D would result in similar impacts to those under Alternative B, but to a lesser degree because there is less acreage within special designations. Overall, the restrictions on prescribed fire under Alternative D would result in similar adverse impacts to private lands as under Alternative B, but to a lesser degree because Alternative D stipulates fuels treatments in less area and performs mechanical fuels treatments and prescribed burns on more acreage (Appendix T).

Resource Uses

Minerals development under Alternative D would result in similar beneficial impacts to prescribed fire as those under Alternative A, but to a lesser degree because less acreage is available for oil and gas development. Utility corridors designated under Alternative D would result in beneficial impacts similar to those described under Alternative A, but to a greater degree than Alternative B. Alternative D manages the second-largest area as ROW avoidance/mitigation or exclusion areas, which would result in proportional adverse impacts to prescribed fire.

Proactive Management

The BLM would use prescribed fire under Alternative D to a similar extent as under Alternative A, but with a greater emphasis placed on using prescribed fire to accomplish resource management objectives.

Management identified in the Northern Zone FMP for prescribed fire monitoring may be carried forward under Alternative D, consistent with management under this alternative. Impacts would be the same as those described for Alternative A.

4.3.3 Stabilization and Rehabilitation

The BLM undertakes stabilization and long-term rehabilitation actions to repair lands damaged by wildfire that are unlikely to recover naturally. Emergency stabilization and burned area rehabilitation

are part of a holistic approach to address post-wildfire issues, including soil impacts, vegetation restoration, invasive species establishment and spread, and damage that can occur resulting from suppression activity and long-term (more than 3 years) restoration. Rehabilitation includes, but is not limited to, contour felling, mulching, seeding, and control of invasive plants.

Emergency stabilization refers to planned actions performed by a Burned Area Emergency Response team within 1 year of containment of a wildfire to stabilize and prevent unacceptable degradation to natural and cultural resources. Burned area rehabilitation refers to efforts undertaken within 3 years of containment of a wildfire to repair or improve fire-damaged land unlikely to recover naturally to desired management conditions, or to repair or replace minor facilities damaged by fire. The spread of cheatgrass, in particular, is possible in areas burned or disturbed due to fire suppression activities. Widespread presence of cheatgrass can alter the local fire regime and fire-recurrence interval.

This analysis describes the impacts to stabilization and rehabilitation in relation to fire and fuels management. Impacts to stabilization and rehabilitation directly affect the management of fire and fuels and the potential for future fire occurrence and spread. Beneficial impacts to fire and fuels management results from management actions that encourage appropriate stabilization and rehabilitation following a wildfire. Adverse impacts to fire and fuels management result from management that limits stabilization and rehabilitation activities.

Direct impacts to stabilization and rehabilitation include restrictions that prohibit or limit stabilization and rehabilitation actions or techniques.

4.3.3.1 Methods and Assumptions

Section 4.3.1 *Wildfire* describes methods and assumptions used in the analysis of impacts to fire and fuels management (including stabilization and rehabilitation).

4.3.3.2 Summary of Impacts by Alternative

The principle impacts to stabilization and rehabilitation in relation to fire and fuels management result from management that affects the occurrence and spread of wildfire, and management that limits or restricts rehabilitation and stabilization tactics or activity. Under all alternatives, the BLM conducts stabilization and rehabilitation consistent with BLM policy and guidance and in accordance with the Northern Zone FMP. An increase in fire suppression restrictions associated with wildfire management (as described in Section 4.3.1 *Wildfire*) that increases the potential for wildfire occurrence and spread in the short term may increase the need for stabilization and rehabilitation as more wildfires occur. However, intensive fire suppression that reduces the natural role of fire in the ecosystem may result in large catastrophic wildfires in the long term that require more-intensive stabilization and rehabilitation activities. Restrictions on wildfire suppression are greatest under Alternative B. There are no restrictions or limitations on stabilization and rehabilitation in specific areas under any of the alternatives.

4.3.3.3 Detailed Analysis of Alternatives

Stabilization and rehabilitation efforts relate directly to the occurrence of wildfires. Funding for stabilization and rehabilitation activities comes from fire funds for the suppression of wildfire. As a result, impacts to stabilization and rehabilitation reflect impacts to management of fire and fuels described in Section 4.3.1 *Wildfire*. Management that increases the occurrence and spread of wildfire (or decreases fire suppression) would impact stabilization and rehabilitation.

Impacts Common to All Alternatives

Implementing the BLM Emergency Stabilization and Rehabilitation standards in the DOI *Interagency Burned Area Emergency Response Guidebook* (DOI 2006b) and *BLM Burned Area Emergency Stabilization and Rehabilitation Handbook* (BLM 2007b) would result in beneficial impacts to fire and fuels management in the Planning Area by prescribing activities that would successfully rehabilitate areas following a wildfire and reduce the potential for future fires in burned areas.

Achieving a balance between treating areas that have departed from the historic fire regime (FRCC 3) and areas that are functioning within an appropriate fire regime (FRCC 1) would result in beneficial impacts on fire and fuels management. Treatment in FRCC 3 areas to return the fire ecology to the appropriate historic fire regime would help decrease fuel loading in these areas and require additional rehabilitation and stabilization to ensure that these areas recover. Without appropriate stabilization and rehabilitation in FRCC 2 and 3 areas, the potential for the occurrence and spread of wildfire in these areas would increase.

Using certified noxious weed-free vegetation products on all BLM-administered land (including during rehabilitation and stabilization activities) would result in beneficial impacts on fire and fuels management by decreasing the potential for the establishment of noxious weeds following seeding of rehabilitated areas.

Alternative A

Under Alternative A, the Northern Zone FMP would continue to guide stabilization and rehabilitation. Impacts to the fire and fuels program would result from increased workload associated with writing and implementing an Emergency Stabilization and Response plan for rehabilitation activities, in coordination with other appropriate agencies, landowners, and affected livestock operators. Consistent with the Northern Zone FMP, treatment in and around a disturbed area affected by wildfire would continue until resource specialists determine there is no longer a threat of noxious weeds. If necessary, this treatment would continue beyond the timeframe for Emergency Stabilization and Response funding.

As described in the Northern Zone FMP, the BLM would perform baseline and post-rehabilitation monitoring under Alternative A. Post treatment monitoring is required to determine the accomplishment of direct treatment objectives and resource management objectives. Monitoring rehabilitation efforts would follow the same general protocol as described for prescribed fire, to the extent practical. Monitoring stabilization and rehabilitation would provide appropriate evaluation and documentation of rehabilitation activities, which may increase the efficiency and effectiveness of future rehabilitation activities to meet resource objectives, reduce fuel loading, and reduce the potential for additional fires in the area. This would result in beneficial impacts to fire and fuels management.

Alternative B

There is no separate management under Alternative B for stabilization and rehabilitation activities following a fire. Similar to Alternative A, the BLM would perform stabilization and rehabilitation consistent with the *BLM Emergency Stabilization and Rehabilitation* standards in the *DOI Interagency Burned Area Emergency Response Guidebook* (DOI 2006b) and *BLM Burned Area Emergency Stabilization and Rehabilitation Handbook* (BLM 2007b).

In addition, the BLM may carry forward under Alternative B stabilization and rehabilitation activities and monitoring identified in the Northern Zone FMP, with impacts similar to those described for Alternative A.

Alternative C

There is no separate management under Alternative C for stabilization and rehabilitation activities following a fire. Similar to alternatives A and B, the BLM would perform stabilization and rehabilitation consistent with the *BLM Emergency Stabilization and Rehabilitation* standards in the *DOI Interagency Burned Area Emergency Response Guidebook* (DOI 2006b) and *BLM Burned Area Emergency Stabilization and Rehabilitation Handbook* (BLM 2007b).

In addition, the BLM may carry forward under Alternative C stabilization and rehabilitation activities and monitoring identified in the Northern Zone FMP, with impacts similar to those described for Alternative A.

Alternative D

There is no separate management under Alternative D for stabilization and rehabilitation activities following a fire. Similar to alternatives A, B, and C, the BLM would perform stabilization and rehabilitation consistent with the *BLM Emergency Stabilization and Rehabilitation* standards in the *DOI Interagency Burned Area Emergency Response Guidebook* (DOI 2006b) and *BLM Burned Area Emergency Stabilization and Rehabilitation Handbook* (BLM 2007b).

In addition, the BLM may carry forward under Alternative D stabilization and rehabilitation activities and monitoring identified in the Northern Zone FMP, with impacts similar to those described for Alternative A.

4.4 Biological Resources

Vegetation Resources

Impacts Common to All Alternatives

This section describes potential impacts to all vegetation types (Map 29) under all alternatives. The sections that follow describe potential impacts to individual vegetation resources (i.e., forests and woodlands, grasslands and shrublands, or riparian/wetland resources).

There would be surface disturbance under all alternatives, and all alternatives apply BMPs for surface-disturbing activities. Surface disturbance directly affects plant communities through vegetation removal and mechanical damage to plants. Indirect impacts to vegetation from surface disturbance on vegetation include soil compaction, alteration of soil horizons, erosion, changes in hydrology, and invasive species encroachment. These indirect impacts would limit recovery or rehabilitation of vegetation communities following disturbance. Conversely, vegetation treatments (e.g., mechanical treatments, fire), while involving short-term disturbance, would result in long-term beneficial impacts to vegetation communities. Vegetation treatments would pursue objectives to increase species and structural diversity, control invasive species, improve the quality and quantity of vegetation for wildlife and livestock, restore habitat connectivity, and create or maintain the desired vegetation structure.

Depending on the air quality conditions in the area at the time of proposed treatments, the BLM may implement restrictions on prescribed burns and vegetation treatments in forests and woodlands to maintain air quality. Planning and timing restrictions on vegetation treatments to minimize emissions associated with fugitive dust or smoke would result in short-term adverse impacts to forests, woodlands, and forest products.

Development of facilities and infrastructure associated with transportation networks, minerals, and recreation would increase habitat fragmentation in the Planning Area, could remove vegetation, and contribute to the introduction and the spread of invasive species. ROWs concentrated in a corridor tend to localize or confine disturbance to a smaller area and reduce disturbance in areas identified as sensitive.

Renewable energy development, especially in the form of wind turbines, could result in adverse impacts by fragmenting vegetation communities and requiring mechanized maintenance that has the potential to make these communities more vulnerable to invasive species establishment and wildfire. However, there are no current or pending ROW authorizations for wind facilities in the Planning Area. The limited projected surface disturbance from these activities would have a minimal impact on vegetation.

Recreation use in vegetation communities could result in indirect short-term adverse impacts from unplanned ignitions and unauthorized woodcutting in forestlands in and adjacent to campgrounds, and degradation of vegetation along trails and roads. Unless properly designed and managed, the development of recreation trails, both motorized and nonmotorized, could erode soils, which would cause adverse impacts to vegetation communities. Increased development of nonmotorized and motorized trails and trailheads can increase recreational use and associated impacts to vegetation communities (e.g., the potential spread and establishment of invasive species and risk of unplanned ignitions) over time. Adverse impacts would generally be more intense from roads and trails that allow motorized vehicle use.

Using the *Wyoming Standards for Healthy Rangelands* (Appendix N) to determine the minimum acceptable conditions for public rangelands would improve the health and diversity of vegetation communities. Impacts to vegetation from livestock grazing management on BLM-administered lands include the removal of forage by livestock, which may alter the amount, condition, composition, and vigor of vegetation. Grazing during the growing season or summer months may reduce the vigor of desired species and change in species composition. Livestock concentration around supplemental minerals or water would disturb soil, remove vegetation, and alter plant community composition.

Livestock and, to a lesser extent, wild horses and wildlife would contribute to the introduction and spread of invasive species, including noxious weeds. Livestock, wild horses, and wildlife may transport seeds of invasive species into the Planning Area (Bartuszevige and Endress 2008). Areas where animals concentrate and disturb the soil would be particularly vulnerable to infestations of invasive species. Range improvements that disturb the soil surface would provide locations for invasive species to become established. Heavy grazing of native vegetation may increase the susceptibility of an area to invasive species infestation. However, livestock grazing management that promotes healthy ecosystem function would create conditions more resistant to the spread of invasive species.

The BLM anticipates that potential impacts from VRM classifications, soil and water resources, air quality, invasive species, NHTs and other historic trails, transportation, wildlife, and special status species would influence the location, size, and shape of vegetation treatments and restrict the location and construction of access roads for activities such as forest and woodland treatments.

Summary of Impacts by Alternative

Certain types of management that restrict surface-disturbing activities and other resource uses would generally protect vegetation communities. Table 4-8 provides an overview of select protective management actions by alternative for each plant community in the Planning Area. The purpose of this table is to provide a broad overview comparison of the alternatives. The proceeding sections further discuss the effects of these and other management actions for each plant community.

Table 4-8. Comparison of Acres of Protective Management by Alternative Encompassing Different Plant Communities

Protective Management	Alternative	Plant Community					
		Forests and Woodlands	Grasslands	Nonnative Annual Brome	Riparian	Sagebrush	Salt Desert Shrub
Locatable Minerals - Closed	A	15,670	6,963	114	1,610	19,175	15,226
	B	46,582	21,941	114	2,346	124,819	66,563
	C	4,274	1,519	0	1,327	7,915	8,264
	D	5,171	2,881	114	1,609	17,303	15,381
Oil and Gas Constraints - Closed	A	17,499	8,922	30	569	45,985	80,243
	B	236,801	55,571	31,961	18,764	1,289,779	615,011
	C	14,353	8,116	30	564	42,842	80,243
	D	59,007	23,420	30	1,533	126,378	77,670
Oil and Gas Constraints - Major	A	212,220	58,472	32,018	36,970	791,774	226,757
	B	191,321	64,733	12,484	18,775	528,006	428,071
	C	34,905	7,671	1,166	36,925	70,882	53,184
	D	14,850	664	0	33,719	23,023	34,851

Table 4-8. Comparison of Acres of Protective Management by Alternative Encompassing Different Plant Communities (Continued)

Protective Management	Alternative	Plant Community					
		Forests and Woodlands	Grasslands	Nonnative Annual Brome	Riparian	Sagebrush	Salt Desert Shrub
Oil and Gas Constraints - Moderate	A	181,199	55,609	9,556	0	800,764	702,880
	B	37,430	35,566	2,016	0	84,996	273,000
	C	254,658	71,036	34,040	49	1,127,262	641,005
	D	366,009	96,757	46,530	2,227	1,697,541	1,222,109
ROW - Exclusion	A	4,661	1,819	653	24,036	16,513	12,023
	B	26,820	6,347	5,754	2,443	136,239	39,024
	C	19	0	0	1,366	253	5,091
	D	1,048	48	0	2,218	4,316	23,977
Lands with Wilderness Characteristics[1]	A	N/A	N/A	N/A	N/A	N/A	N/A
	B	48,987	19,175	938	6,835	201,007	271,671
	C	N/A	N/A	N/A	N/A	N/A	N/A
	D	16,948	10,381	0	221	19,624	1,581
Livestock Grazing - Closed	A	384	45	9	1,885	609	1,900
	B	209,914	44,658	33,806	19,655	1,137,889	504,989
	C	384	45	9	1,885	609	1,899
	D	384	45	9	1,885	609	1,900
ACEC	A	18,388	11,265	0	281	28,230	6,780
	B	68,398	14,915	0	1,059	141,642	65,926
	C	3,202	1,519	0	0	7,362	0
	D	26,924	12,718	0	357	42,736	14,033
WSR	A	9,224	5,139	0	1,380	10,886	0
	B	9,224	5,139	0	1,380	10,886	0
	C	N/A	N/A	N/A	N/A	N/A	N/A
	D	N/A	N/A	N/A	N/A	N/A	N/A
WSAs	A	10,919	6,766	30	563	42,727	81,355
	B	10,919	6,766	30	563	42,727	81,355
	C	10,919	6,766	30	563	42,727	81,355
	D	10,919	6,766	30	563	42,727	81,355

[1]Includes only lands designated as Wild Lands.
Sources: USGS 2008c; BLM 2009a

N/A not applicable
ACEC Area of Critical Environmental Concern
ROW rights-of-way
WSA Wilderness Study Area
WSR Wild and Scenic River

4.4.1 Vegetation – Forests, Woodlands, and Forest Products

Actions that restrict forest management practices or contribute to the decline in abundance, distribution, or health of forests or woodlands, and availability, quality, and quantity of forest products would result in adverse impacts. Conversely, actions that enhance management, improve health, and protect and restore forests and woodlands in the Planning Area provide beneficial impacts.

Direct impacts to forests, woodlands, and forest products result from management actions that affect forest structure, species composition/diversity, vigor, health, vegetative community type, or other forest/woodland characteristics. Management actions that limit timber availability and restrict timber

extraction methods directly affect forest products. Indirect impacts to forests, woodlands, and forest products include any change in forest and woodland characteristics due to natural forces (e.g., insect and disease, fire and drought conditions), management actions from other resources, or failure to implement management actions.

In addition to human activities, natural processes could produce beneficial or adverse impacts to forest and woodland communities. In an old growth forest, natural regeneration restores genetic diversity, sustained yield, and uneven-aged stands that provide economic benefits such as continuous production, insect and disease control, soil and water conservation, and the elimination of planting costs. Alternatively, natural regeneration can introduce conifers into aspen stands, thereby reducing the size of, or out-competing the aspen stands. Aspen stands create natural fuel breaks and provide other benefits such as scenic qualities and habitat for wildlife. Refer to Map 29 for forest and woodland resources.

4.4.1.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- No current forest or woodland inventory or age and species classifications are available for the Planning Area.
- The condition, species content, and vitality of the forest and woodland ecosystem rest on the foundation of the soils, topography, slope/aspect, and microclimate and climatic forces specific to the region.
- Distributing and managing vegetative treatments will vary in forest and woodland areas depending on the desirable goals (e.g., fuel reduction in a WUI area).
- Livestock grazing in forests and woodlands generally remains compatible with forest management under all alternatives. Many forests and woodland areas are inaccessible to livestock due to steep slopes, physical barriers, or proximity to other portions of grazing allotments.
- Old growth stands, or those the BLM would manage for old growth, will follow the Healthy Forests Restoration Act (2003) Section 102 for maintaining and managing these stands.
- Public demand sales for firewood, Christmas trees, posts and poles, and other forest products would continue.
- Forest health, forest restoration, and hazardous fuels reduction objectives will be the major determining factors in forest management.
- Forests and woodlands are important for the watershed, visual resources, and wildlife habitats. Some of these values are natural and some are sociological. For example, wildlife needs habitat, not visual quality. Human, sociological, economic, and cultural influences relate to managing forestlands and must be considered.
- Management of the forest could increase the water yield from the forest.
- Water quality could be adversely impacted in the short term due to mechanical forest treatments (soil erosion, etc.), but overall, the consequences of these treatments, as related to water quality, are anticipated to be negligible.
- Aspens generally are declining due to advancement of ecological conditions and succession. The advancement of ecological conditions also leads to encroachment of evergreen species into aspen stands; for example, shade-tolerant conifers invade and eventually shade out aspen stands, contributing to their decline.

4.4.1.2 Summary of Impacts by Alternative

Impacts to forests, woodlands, and forest products would result from surface-disturbing activity or actions that increase the chance of catastrophic wildfire or degrade forest health through increased erosion and disease. Surface disturbance would adversely affect forests and woodlands under all alternatives, but would have the greatest impact under Alternative C, followed by alternatives D, A, and B. Alternative C would also place the least restrictions on motorized vehicle use and new road construction, which, in addition to increasing erosion, would increase the risk of unplanned ignitions and unauthorized woodcutting that would degrade forest health. Beneficial impacts to forests and woodlands would result from more intense forest management practices and silvicultural treatments that would improve forest health and reduce the risk of catastrophic wildfires, which pose the greatest threat to forests and woodlands. Forests products would also benefit from similar treatments that increase the availability of commercially viable stands. Alternative C, followed by alternatives D, A, and B, implements the largest number of silvicultural practices and other treatments to actively manage forests and woodlands. Beneficial impacts would also result from management actions that restrict surface-disturbing activities within certain specially managed areas, such as ACECs, where forests and woodlands are present. However, such actions may also limit silvicultural treatments in certain areas. Alternative B manages the most acres of forests and woodlands within ACECs followed by alternatives D, A, and C. Therefore, while Alternative B would result in the least surface-disturbing activity that may affect forests and woodlands, it would also place the most restrictions on proactive management that would improve forest health and reduce the risk of catastrophic fire.

4.4.1.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

In addition to the impacts described above, the following paragraphs provide a general description of potential impacts to forests, woodlands, and forest products that would not differ among alternatives.

Forest management, including timber harvest, would contribute to improving overall forest health throughout the Planning Area. These types of actions would reduce the potential for catastrophic fires, reduce the number of diseased trees, enhance age and species diversity, and reduce the spread of invasive species. Specific proactive management actions common to all alternatives would restore the historic processes, composition, and structures of forests and woodlands, thereby maintaining the desired harvest level.

There would be direct long-term adverse impacts to forest management in localized areas of new significant cultural resources discoveries, because these sites would require protection. Such cultural sites could restrict the location of vegetative treatments and access roads, thereby decreasing the accessibility and the forest acreage available for treatments.

Consolidation of land ownership would have a long-term beneficial impact on forest resources through facilitation of management actions in blocks of forestland. If implemented, forest management activities would not be constrained by ownership boundaries. Easement acquisition and land tenure adjustments would help enhance access and aid in implementing forest management actions. Objectives for acquiring or maintaining access to forested areas would keep these areas open to active forest management. Conversely, land transactions could fragment ownership and impact management of forests, woodlands, and forest products if management objectives are inconsistent; however, the low level of land designated for possible disposal would have negligible impacts on forests, woodlands, and forest products in the Planning Area as a whole.

Short-term impacts regarding the timing or location of vegetative treatments and the availability of forest products could result from temporary CSU restrictions, seasonal NSO restrictions, or no surface development restrictions within buffers for specials status species and raptor nest sites in forests and woodlands. Seasonal restrictions for forest management may apply to existing or newly designated ACECs, WSAs, or Wild Lands.

Alternative A

Surface Disturbance

Alternative A would result in approximately 15,710 acres of long-term surface disturbance that may contribute to the decline in abundance, distribution, or health of forests and woodlands (Table 4-1). The BLM projects 30,000 acres of short-term surface disturbance from silvicultural treatments (Appendix T). Short-term surface disturbance would increase the potential for short-term adverse impacts to forests and woodlands through soil erosion and potential spread of invasive species. The use of BMPs would minimize these impacts. The long-term benefits from silvicultural treatments would reduce the likelihood of catastrophic fire through fuel removal, increase opportunities for natural regeneration, and control insects and disease. The use of silvicultural treatments may also create beneficial impacts by altering forests and woodlands toward DPC. The degree to which these treatments would alter forests and woodlands toward DPC would depend on the location, timing, and other factors of the treatments.

Resource Uses

Under Alternative A, oil, gas, and other minerals development would involve 25,390 acres of short-term surface disturbance, a portion of which could adversely impact forests and woodlands by contributing to a decline in abundance, distribution, or health (Appendix T). Under Alternative A, most of the Planning Area remains open to mineral extraction, and the extent of RFD of minerals facilities is second greatest under this alternative compared to the other alternatives. Most of the impacts would be temporary during the life of the operation, with most areas of disturbance reclaimed following closure of operations; however, short-term adverse impacts from minerals development would include forest health degradation and habitat fragmentation.

Alternative A permits motorized vehicle use on existing roads and trails in most of the Planning Area. The level of public access granted from motorized travel may increase the potential for unplanned ignitions, unauthorized woodcutting, and the spread of invasive species. This would result in adverse impacts to forests, woodlands, and forest products. Permitting off-road motorized vehicle use in areas with limited travel designations to access dispersed campsites would result in road and trail proliferation that would increase erosion, degrade vegetation, and increase the potential for unplanned ignitions, adversely affecting forests, woodlands, and forest products.

Special Designations

Special designations could beneficially impact forests and woodlands if they place additional restrictions on activities that contribute to forest decline or degrade forest health (e.g., long-term surface disturbance). Special designations also could adversely impact forests and woodlands and forest products when they restrict vegetation treatments to achieve DPC or limit timber extraction availability or methods. Under Alternative A, the forests and woodlands in ACECs (see Table 4-8) would experience limited beneficial impacts due to restrictions on surface-disturbing activities and motorized travel. However, when restrictions limit certain silvicultural treatments they would adversely affect forests, woodlands, and forest products. Alternative A restricts motorized vehicle use in WSAs, which would reduce the likelihood of unplanned ignitions and could result in beneficial impacts.

Resources

Under Alternative A, wildland fire is used to restore fire-adapted ecosystems and to reduce hazardous fuels. Wildland fire at the appropriate intensity would provide beneficial impacts to forests and woodlands in the short term by reducing hazardous fuels to decrease the chance of stand-replacing fires, and in the long term, by diversifying stand age and improving forest health.

Management actions specific to wildlife and special status species could beneficially impact forests and woodlands if they restrict activities that degrade forest health. Conversely, they could adversely impact forests, woodlands, and forest products if they restrict forest management practices (e.g., vegetation treatments) or extraction activities. Under Alternative A, a seasonal TLS to prohibit all activity within a ¾-mile radius of active special status raptor species nests would restrict forest management practices, which may adversely impact forests, woodlands, and forest products. The BLM restores and maintains 25 to 200 acres of aspen stands per year for wildlife values until the number of managed acres reaches 2,000 to 4,000. This increases woodland abundance. Wildlife grazing and browsing could adversely impact the regeneration of aspen and other trees and shrubs.

Proactive Management

Alternative A allows harvesting in commercial forestland in a manner that protects and benefits watershed, wildlife, and riparian/wetland habitat values and emphasizes areas where forest health is a primary concern. This management would create long-term beneficial impacts, both to forests and forest products, by maintaining or improving forest health and improving the quality of forest products over the life of the plan. Under Alternative A, the BLM generally closes timber access and haul roads after completion of timber management, which limits vehicle access and the associated risk of unplanned ignitions and the spread of invasive species. This could beneficially impact forests.

Alternative A allows precommercial thinning in overstocked areas and regenerated timber sale areas when trees reach the 20- to 30-year age class, which would reduce stand density and allow the healthiest trees to grow faster to harvest. This would create long-term beneficial impacts to forest products. In addition, reducing stand density makes forests more resistant to bark beetle infestation (Leatherman et al. 2007), and salvaging infested stands can slow the spread of bark beetles while preventing other safety hazards associated with dead stands (USFS 2007b). Forest management actions under Alternative A slow the spread of bark beetles and result in beneficial impacts to forests.

Precommercial thinning also can benefit forests and woodlands in the long term, if performed at the appropriate intensity, by reducing the fuel load and the chance of catastrophic wildfire. Under this alternative, the BLM manages wildland fire and logging or timbering whenever possible to revitalize decadent stands, improve stand density, and increase canopy cover. This management action would benefit forest health but would not benefit forest products. Alternative A permits clear-cuts of no more than 900 feet in any direction, unless a long-term benefit to habitat results, which would create beneficial impacts to forest products by maintaining timber availability. However, clear-cuts could adversely affect forest health if they are large enough to substantially alter the microclimate or regeneration time of the forest or substantially increase soil erosion.

Planting conifer areas denuded by wildfire or harvesting if they do not regenerate naturally within 15 years of the disturbance would beneficially impact forest products by accelerating regeneration and therefore reducing the rotation time between harvests. Proactive management actions, such as performing woodland treatments in aspen and juniper stands and managing juniper and limber pine stands to improve forest health conditions, would create beneficial impacts to forests and woodlands by improving forest health or increasing the abundance, distribution, and stand diversity of forests and

woodlands. Alternative A employs a variety of silvicultural practices (e.g., clear cutting, shelterwood, tree and group selection) to accomplish forest health goals, which, if effects remain consistent with forest health objectives, would beneficially impact forests, woodlands, and forest products.

Alternative B

Surface Disturbance

Alternative B would result in 31 percent less acreage of long-term surface disturbance that may contribute to the decline in abundance, distribution, or health of forests and woodlands than Alternative A (Table 4-1). Alternative B would involve approximately 20,000 acres of short-term surface disturbance from silvicultural treatments, which would have fewer short-term adverse impacts on forests and woodlands than Alternative A. However, because fewer acres would be subject to treatment, Alternative B would have fewer long-term beneficial impacts on forests and woodlands (Appendix T). Under Alternative B, the potential for catastrophic fire would be greater and the ability to reduce insects and disease would be less than under Alternative A. The use of silvicultural treatments would create beneficial impacts of altering forests and woodlands toward DPC as identified similar to Alternative A, although to a lesser degree because of the smaller treatment area.

Resource Uses

Under Alternative B, oil, gas, and other minerals development would involve 17,327 acres of short-term surface disturbance (Appendix T), a portion of which may adversely impact forests and woodlands by contributing to a decline in abundance, distribution, or health of these areas. Although most of the Planning Area remains open to mineral extraction, compared to the other alternatives, Alternative B has the least RFD of minerals facilities. Most of the impacts would be temporary during the life of the operation with most areas of disturbance reclaimed following closure of operations. However, there may be short-term adverse impacts from minerals development, including forest health degradation and habitat fragmentation. Alternative B would result in the least adverse impact to forests and woodlands from minerals development.

Alternative B limits motorized vehicle use to designated roads and trails in most of the Planning Area, which would result in impacts similar to those under Alternative A, but to a lesser degree. Restricting motorized vehicle use to fewer travel routes also may adversely impact forest products by limiting access for commercial timber harvest. Prohibiting off-road motorized vehicle use for dispersed campsite establishment in areas with limited travel designations would eliminate the potential for new road and trail proliferation and reduce the impacts from this management action described under Alternative A.

Special Designations

Under Alternative B, the BLM manages a greater portion of forests and woodlands in the Planning Area within special designation areas (see Table 4-8). The BLM designates the Sheep Mountain and Rattlesnake Mountain ACECs, which contain aspen and conifer stands, under Alternative B. These ACECs implement restrictions on surface-disturbing activities and motorized vehicle use, and the BLM manages them as renewable energy and ROW avoidance/mitigation areas. The BLM allows, where feasible, and stipulates vegetation and silvicultural treatments and fuels management in these ACECs. Alternative B closes WSAs to motorized vehicle use. Under Alternative B, the BLM restricts minerals development, road construction, and motorized vehicle use, while allowing vegetation treatments and prescribed fire, in LWCs (all of which are designated as Wild Lands under this alternative). These management actions would beneficially impact forests and woodlands in these areas by maintaining their abundance and reducing the chance for wildfire. However, Alternative B also closes LWCs to commercial or personal-

use woodcutting, adversely affecting forest products by reducing their availability and eliminating the ability to performing commercial aspen and bark beetle treatments that would improve forest health. Special designations under Alternative B would involve more stipulations and restrictions applied to vegetative and silvicultural treatments and motorized vehicle use than Alternative A, which may result in limited adverse impacts to forest health and the availability of forest products. Overall, special designations under Alternative B would create more beneficial impacts to forests, woodlands, and forest products than under Alternative A by increasing restrictions on activities and resource uses that can degrade forest health or increase the chance of wildfire.

Resources

Under Alternative B, the BLM utilizes wildland fires to restore fire-adapted ecosystems for natural resource systems and to reduce hazardous fuels, resulting in similar beneficial impacts to those described under Alternative A. Most of the Planning Area is in FRCC Classes 2 and 3, which have the highest risk of catastrophic fire and of having lost or losing key ecosystem components (see Section 4.3 *Fire and Fuels Management*). Alternative B emphasizes natural processes that would take longer to achieve forest health objectives compared to the other alternatives. This type of vegetation management would increase the risk, versus the other alternatives, that Alternative B would be inadequate to diversify fuel conditions enough to substantially reduce the risk of catastrophic fire.

Under Alternative B, a TLS to prohibit activity within a 1-mile radius of active special status raptor species nests would have a greater adverse impact on forests, woodlands, and forest products than under Alternative A. Under Alternative B, the Absaroka Front Management Area, which is not managed under Alternative A, restricts some resource uses (e.g., mineral leasing and motorized vehicle use) that would reduce the abundance, distribution, or health of the 48,794 acres of forests and woodlands in its boundaries. Management of this area would allow silvicultural/vegetation and fuels treatments that would benefit forest and woodland health and forest products. Silvicultural practices are prohibited in elk parturition habitat under Alternative B, which would adversely impact forests and woodlands, by prohibiting practices that could improve forest health (e.g., fuels reduction) and forest products, by reducing their availability. Alternative B restores 100 acres of aspen stands per year with similar beneficial impacts as identified under Alternative A.

Proactive Management

Under Alternative B, the BLM manages forests and woodlands for watershed stability, wildlife habitat, and forest health with an emphasis on natural processes to manage towards achieving forest health objectives. Alternative B permits timber harvesting only where natural processes are unable to accomplish forest health goals, which would result in adverse impacts to forest products by reducing their availability. The BLM closes timber access and haul roads no longer required, which would create beneficial impacts similar to those under Alternative A by limiting motorized vehicle access. Alternative B only allows precommercial thinning for fuels treatment, which would create beneficial impacts to forests and woodlands by reducing fuel loads and the chance of catastrophic fire, and to forest products by improving future harvest quality. However, forest management actions under Alternative B may result in denser, more mature stands with less diverse age structure. Compared to the other alternatives, this would result in the greatest adverse impact by increasing the risk of the spread of bark beetles. Overall, management of precommercial thinning under Alternative B is more restrictive than the other alternatives and would benefit forest products and forest health the least compared to other alternatives.

Alternative B prohibits clear-cuts, which would beneficially affect forest health by preventing potential soil erosion. Conversely, prohibiting clear-cuts would adversely affect forest products by decreasing

timber availability and restricting extraction methods, and would eliminate a management tool useful in the regeneration of early successional species (e.g., aspen and lodgepole pine) and treatment of insects and diseases. Additionally, restrictions on timber harvesting on BLM-administered lands may increase harvesting on private or other federal and state lands to make up for decreased availability on BLM-administered lands.

The BLM plants conifer areas denuded by wildfire and harvesting if they do not regenerate naturally within 20 years, resulting in less benefits to forest products than Alternative A, due to the longer rotation time. The BLM limits vegetative treatments and forest management only to areas where natural processes do not achieve forest health goals. The use of primarily natural processes to improve forest health would reduce the potential for erosion and the spread of invasive species, which would be short-term beneficial impacts. However, this practice could slow the rate of fuels production, thereby increasing the risk of catastrophic fire. This would result in long-term adverse impacts to forest health.

Under Alternative B, long-term beneficial impacts to old growth forests would result from managing for no net loss of this forest stand type over a 30-year period and in an appropriate proportion to other timber classes in an HUC Level 4 sub-basin. Such management would be more beneficial for old growth forest stands than Alternative A, where no specific management exists, but would lead to greater adverse impacts to forest products availability and slower production of new timber in areas managed for old growth than under Alternative A.

Alternative C

Surface Disturbance

Alternative C would result in approximately 164 percent more acreage of long-term surface disturbance that may contribute to the decline in abundance, distribution, or health of forests and woodlands than Alternative A (Table 4-1). Alternative C would result in 40,000 acres of short-term surface disturbance from silvicultural treatments (Appendix T). Potential short-term adverse impacts to forests and woodlands from surface disturbance would be greatest under Alternative C. However, compared to the other alternatives, under Alternative C potential long-term beneficial impacts from these treatments are greatest. Long-term beneficial impacts include reducing the risk of catastrophic fire, increasing opportunities for natural regeneration, and reducing the spread of insects and disease. The use of silvicultural treatments would create the benefits of altering forests and woodlands toward DPC similar to Alternative A, although to a greater degree because the treatment area would be larger.

Resource Uses

Under Alternative C, oil, gas, and other minerals development would involve 25,771 acres of short-term surface disturbance, a small portion of which could adversely impact forests and woodlands by contributing to a decline in abundance, distribution, or health (Appendix T). Most of the Planning Area remains open to mineral extraction, and the RFD of minerals facilities is the greatest under Alternative C. Most of the impacts would be temporary during the life of the operation, with most areas of disturbance reclaimed following closure of operations. However, short-term adverse impacts from minerals development include forest health degradation and habitat fragmentation. Alternative C would result in the greatest adverse impacts to forests and woodlands from minerals development.

Alternative C would result in impacts from motorized vehicle use similar to those under Alternative A, but to a greater degree. The BLM limits motorized vehicle use to designated roads and trails in a larger area, but also opens a larger area to unrestricted off-road use, with impacts comparable those under

Alternative A. Permitting off-road motorized vehicle use to access dispersed campsites would case impacts similar to those under Alternative A.

Special Designations

Under Alternative C, the BLM manages the smallest acreage of forests and woodlands in the Planning Area within special designations (see Table 4-8). Only two ACECs are designated under this alternative. Although these designations would provide the least beneficial impact to forests and woodlands by limiting long-term surface disturbance, this alternative would result in the least adverse impact from restricting silvicultural treatments that improve forest and woodland health and generate forest products. Motorized vehicle use is less restricted in WSAs, which could create less beneficial impact in these areas by reducing the risk of unplanned ignitions.

Resources

Under Alternative C, the BLM utilizes wildland fires to restore fire-adapted ecosystems for natural resource systems, to reduce hazardous fuels, and to enhance forage for commodity production. This utilization of wildland fire under Alternative C would create beneficial impacts to forests and woodlands similar to Alternative A, and could benefit forest products more if the BLM used prescribed burns to affect forests similarly to precommercial thinning. Under Alternative C, the BLM would use mechanical, chemical, and biological treatments across the landscape as needed to restore vegetative diversity and reduce the risk of larger, more intense fires. This would benefit forests, woodlands, and forest products. Alternative C would present the least risk that vegetation management acreage is inadequate to diversify fuel conditions enough to substantially reduce the risk of catastrophic fire.

Under Alternative C, restrictions around special status raptor nests that potentially limit extraction and management practices are the least stringent, which would result in the least adverse impact to forests, woodlands, and forest products. Limiting motorized vehicle use to designated roads and trails subject to seasonal limitations in the Absaroka Front Management Area would create greater beneficial impacts than Alternative A by reducing the risk of unplanned ignitions in the 48,794 acres of forests and woodlands in the area. However, Alternative C allows more oil and gas development in this area that may adversely impact forests and woodlands. The BLM promotes aspen regeneration under all alternatives and focuses woodland treatments on aspen stands under Alternative C. The BLM does not restore aspen woodlands for wildlife habitat or set a targeted annual acreage of aspen stand regeneration (such as under alternatives A and B) under this alternative; therefore, beneficial impacts from aspen regeneration may be less than under alternatives A and B.

Proactive Management

Under Alternative C, the BLM manages forests and woodlands to achieve a sustained supply of forest products. Alternative C allows timber harvesting in areas classified as commercial timberland, which would create the greatest beneficial impact to forest products by maximizing their availability. The BLM allows timber access and haul roads to remain open to meet other resource goals or for new recreational purposes, which may result in adverse impacts to forests and woodlands by increasing the potential for unplanned ignitions and the spread of invasive species. Alternative C allows precommercial thinning when trees reach the 10- to 20-year age class or are at least 5- to 15-feet tall. This would benefit forest products more than under the other alternatives by releasing the healthiest trees from competition at the earliest age so that they grow faster to harvest. Forest management actions under Alternative C may also result in less dense stands with a more diverse age structure than other alternatives. This would create the most beneficial impacts to forests and woodlands by slowing the spread of bark beetles. Precommercial thinning also could benefit forests and woodlands, if performed

at the appropriate intensity to reduce fuels and the chance of catastrophic fire. Alternative C allows clear cuts up to 100 acres, which would provide greater forest product availability than alternatives A and B and similar availability to Alternative D. Allowing larger clear cuts than under Alternative A may result in more adverse impacts to forests and woodlands, depending on the stand composition and slope of the site, from increasing regeneration time and soil erosion.

Under Alternative C, efforts to retain old growth forest areas at appropriate locations and distribution levels in an HUC Level 4 sub-basin as evaluations occur would result in similar beneficial impacts to those under Alternative B, but to a lesser extent. The less restrictive management under Alternative C may be less beneficial to the retention of this forest type than under Alternative B, but also would result in less adverse impacts to forest products production.

Planting conifer areas denuded by wildfire and harvesting if they do not regenerate naturally within 10 years would create the greatest benefit to forest products compared to the other alternatives. Logging or timbering before wildland fire and other natural processes to improve stand density would benefit forest products by increasing the availability and health of timber. Alternative C employs a variety of silvicultural practices (e.g., clear cutting, shelterwood, tree and group selection) to accomplish forest health goals, which, if effects remain consistent with forest health objectives, would benefit forests and forest products. In general, Alternative C would create the greatest benefit to forest products and more beneficial impacts to forests and woodlands than Alternative A, as long as managing forests for commodity production can reduce fuel levels without degrading forest health.

Alternative D

Surface Disturbance

Alternative D would result in approximately 17 percent more acreage of long-term surface disturbance that may contribute to the decline in abundance, distribution, or health of forests and woodlands than Alternative A (Table 4-1). Silvicultural treatments would result in impacts to forests and woodlands similar to those under Alternative A. Under Alternative D, the potential for catastrophic fire would be similar to Alternative A and the ability to reduce insects and disease would be similar to that under Alternative C. The use of silvicultural treatments to manage forests and woodlands toward DPC would result in impacts similar to those under Alternative A.

Resource Uses

Minerals development under Alternative D would result in impacts to forests and woodlands similar to those under Alternative A. Motorized vehicle use would result in adverse impacts to forests and woodlands similar to Alternative A, although to a lesser degree because the BLM limits motorized vehicle use to designated roads and trails in more areas and limits off-road travel for big game retrieval to within 300 feet of established roads. More limitations on motorized vehicle use would benefit forest products less than Alternative A.

Special Designations

Under Alternative D, the BLM manages more forests and woodlands in special designations than alternatives A and C, but less than Alternative B. The BLM designates the Sheep Mountain ACEC, which would result in impacts similar to those under Alternative B, although to a lesser extent because Alternative D applies fewer restrictions on surface-disturbing activities. The impacts from designating some LWCs as Wild Lands (52,485 acres) under Alternative D would be similar to those described under Alternative B, but to a lesser extent. Restricting motorized vehicle use in WSAs would limit the potential

for unplanned ignitions. This would create more beneficial impacts than Alternative C, but fewer than alternatives A and B.

Resources

Fire and fuels management under Alternative D would result in impacts to forests and woodlands similar to those under Alternative A. Management actions specific to protecting wildlife and special status species and their habitat would result in more adverse impacts to forests, woodlands, and forest products than alternatives A and C, but fewer than Alternative B. Actions to restore aspen woodlands would be similar to those under Alternative C and would result in similar impacts.

Proactive Management

Under Alternative D, proactive management actions for forests, woodlands, and forest products would be similar to those under Alternative A, with more beneficial impacts to forest products from allowing clear cuts up to 100 acres, more precommercial thinning, and managing endemic insects and disease with the full range of silvicultural techniques and treatment methods. Management actions to preserve old-growth stands would benefit forests and woodlands more than under Alternative A, which includes no such actions.

4.4.2 Vegetation – Grassland and Shrubland Communities

Adverse impacts to grassland and shrubland communities include actions that contribute to the decline in abundance or distribution of these communities. Conversely, beneficial impacts to grassland and shrubland communities include actions that protect or restore the communities in the Planning Area.

Direct impacts to grassland and shrubland communities result from surface disturbance and other activities that remove vegetation and cause mechanical damage to plants. Surface-disturbing activities generally result in an adverse direct impact. Activities such as livestock grazing, wildlife use, wildland fire, and vegetative treatments (e.g., planned ignitions, chemical, or biological) also result in direct adverse or beneficial impacts to these communities.

Indirect impacts to grassland and shrubland communities result from activities that alter the quality and health of these communities. For example, activities that compact soil, cause erosion, cause changes in hydrology, and cause invasive species encroachment would cause indirect impacts. Beneficial impacts to grassland and shrubland communities include vegetative treatments to improve these communities and activities that minimize, reduce, or prevent the spread of invasive species into these communities.

4.4.2.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Current trends in plant succession and vegetation health would continue.
- Some existing plant communities likely would not be reestablished to pre-disturbance structure and density for more than 20 years.
- Short-term vegetation impacts depend on the length of time it takes for a disturbed area to become revegetated, generally a 1- to 5-year timeframe.
- Grassland and shrubland communities would be maintained with a mix of species composition, cover, and age classes.
- Based on the definition of surface-disturbing activity (mechanized actions), an increased source of surface disturbance in the Planning Area will be from bentonite and gypsum development.

- Surface disturbances increase the likelihood of the spread of invasive species in an area.
- The placement of supplements can affect the distribution of livestock grazing in grassland and shrubland communities.
- The primary conduit for the initial establishment of the spread of invasive species is through the road network.
- Herbivory use in the form of grazing and browsing is important for maintaining the health of grassland and shrubland communities. Improper or unmanaged herbivory can decrease plant vigor and ground cover, lead to increased erosion, degrade soil nutrients and water retention, and impact rangeland health.
- Grazing practices can maintain, improve, or degrade rangeland health. The *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N) are designed to maintain or improve rangeland health and are applied under all alternatives.
- Fire plays an intricate role in these communities, particularly shrubland communities.
- Prescribed fire is a tool used to manage vegetative communities and can result in short-term adverse impacts with long-term beneficial impacts to wildlife, certain desirable wildlife habitats, and in some cases forage availability and productivity.

4.4.2.2 Summary of Impacts by Alternative

Adverse impacts to grassland and shrubland communities would result from surface-disturbing activities and other actions that alter the distribution and abundance of grassland and shrubland communities and change community structure and diversity. Therefore, management actions that result in more surface disturbance would result in more adverse impacts to these communities. Alternative C would involve the most surface disturbance to grassland and shrubland communities, followed by alternatives D, A, and B. Other adverse impacts may result from concentrated livestock grazing that compacts soil and degrades community health. However, proper grazing practices would reduce the potential for these impacts and may improve resource conditions in certain areas. Under Alternative B, allotment monitoring practices, Allotment Management Plan (AMP) development, livestock flushing practices, and rangeland improvements, would cause the least adverse impacts to grassland and shrubland communities but would also restrict grazing from certain areas where it could be used as a management tool to improve resource conditions.

Reclamation practices under Alternative B would facilitate the restoration of disturbed areas the most, followed by alternatives D, A, and C. Special designations and other resource programs under Alternative B protect the most grasslands and shrublands from surface disturbance and degradation due to off-road motorized vehicle use, followed by alternatives D, A, and C. However, Alternative B would involve the least amount of treatment to prevent wildfires and eradicate invasive species. Alternatives A, D, and C allow for more treatment of grassland and shrubland communities but overall, adverse impacts due to surface disturbance under these alternatives are likely to be greater than under Alternative B. Overall, Alternative C would result in the greatest adverse impact to grassland and shrubland communities, followed by alternatives A, D, and B.

4.4.2.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Impacts to grassland and shrubland communities under the various alternatives would be similar; however, the extent and intensity of impacts would vary by alternative. Therefore, discussions for individual alternatives describe impacts to grassland and shrubland communities from surface-disturbing activities, motorized vehicle use, livestock grazing management, special designations, fire management, wildlife management/use, and proactive management actions under the individual alternatives. The following paragraphs generally describe impacts to grassland and shrubland communities regardless of the alternative selected.

Minerals development impacts to grassland and shrubland communities would include long- and short-term impacts, small and localized removal of vegetative surface cover, and larger disturbances covering many acres. There would be surface disturbance from bentonite and gypsum mining under all alternatives, increasing with the area available for locatable mineral entry. Mineral development would alter the distribution and abundance of grassland and shrubland communities and change community structure and diversity. Long-term impacts would mostly be associated with permanent structures and road construction, but some grassland and shrubland communities would not reestablish to pre-disturbance structure and density for more than 20 years. The severity of impacts would depend on the precipitation zone, amount of activity, and the success of reclamation efforts for disturbed areas. The Impacts Common to All Alternatives section under *Vegetation Resources* describes impacts from other surface-disturbing activities, including ROW development, that would affect grasslands and shrublands.

Motorized vehicle use on public lands may result in adverse short-term and long-term impacts to vegetation in grassland and shrubland communities. A one-time disturbance from off-road motorized vehicle use causes physical damage to vegetation by breaking stems and branches and may disturb the soil surface, depending on soil conditions, slope, and ground cover. With a one-time disturbance, plants and disturbed areas usually recover. However, with repeated use, new trails become established. This results in the long-term reduction of vegetation cover and density, and changes species composition. In areas with significant biological soil crusts, a one-time off-road disturbance can remain visible for many months and is prone to repeated use.

Livestock grazing can cause both adverse and beneficial impacts to vegetation communities. Historically, overgrazing of native perennial grasses has contributed to the spread of nonnative annual grasses (DiTomaso 2000). However, proper grazing in grassland and shrubland communities does not adversely impact rangeland health, and may improve it in certain instances. Manier and Hobbs (2007) found that livestock grazing in sagebrush communities can increase plant species richness and diversity, and Muscha and Hild (2006) found no substantial difference in biological crust cover between areas grazed and areas with light to moderate grazing throughout Wyoming. Improving plant vigor, increasing vegetative cover, and reducing invasive species infestations can occur through removing old growth and decadent vegetation that inhibits new growth. Healthier plant communities are more resistant to the spread of invasive species and other undesirable plant species. Livestock grazing of noxious weeds at crucial points in their life-cycles can decrease the spread of invasive species. Proper livestock grazing management also increases a plant community's resistance to cheatgrass invasion after a disturbance such as wildland fire (Davies et al. 2009).

Under all of the alternatives, wild horse grazing—if concentrated or localized year-round—within HMAs may result in adverse impacts to grassland and shrubland communities by compacting soils and

removing vegetation. Expanding the McCullough Peaks HMA under alternatives B and D may increase the extent of adverse impacts to grasslands and shrublands from concentrated wild horse grazing.

Wildland fire and prescribed fire have both adverse and beneficial impacts to grassland and shrubland communities. In the short term, wildland fires remove vegetation and create an opportunity for the establishment or spread of invasive and noxious weeds. Many invasive species respond rapidly after fire, and can out-compete native species. In areas where invasive species are present, wildland fire increases the likelihood of invasive species expansion. Firefighters and their equipment may also introduce or spread invasive species. Some mechanical control activities disturb the soil surface and remove vegetation, creating an opportunity for invasive species to become established or spread.

In the long term, because of the role fire historically played in these communities, fire would increase vegetative diversity across the landscape, rejuvenate decadent plants, and improve the overall health of these communities. In shrubland communities, impacts from fire usually are long-term and depend on the scale and severity of the disturbance. The potential for sagebrush shrublands to return after fire depends on the acreage burned, the distance to seed sources, and the spread of invasive species, such as cheatgrass, which can increase fire frequency. Limiting or protecting acreage from fire may, in some cases, lessen direct loss of grassland and shrubland communities and reduce the potential spread of invasive species in the short term. However, considering the historic role of fire in maintaining vegetative composition and structure, the lack of fire may decrease the overall health of these communities. Wildlife impacts to vegetation depend on population levels, the distribution of animals, and the ability of animals to move. Crucial winter ranges for mule deer and pronghorn, where shrubs are heavily used, may exhibit vegetation shifts from sagebrush, bitterbrush, and mountain mahogany to conifers, grasses, forbs, and annuals, and in some cases, bare ground. Management actions that prohibit surface-disturbing activities to protect special status species, such as the greater sage-grouse, in grassland and shrubland communities also would benefit vegetation in these areas.

Specific proactive management actions common to all alternatives would benefit grasslands and shrublands to ensure that the selected alternative will meet the goals and objectives for these resource programs. Proactive management actions common to all alternatives include managing vegetative communities in accordance with the *Wyoming Standards for Healthy Rangelands* (Appendix N) and continuing to use ecological site descriptions; continuing to regularly monitor and evaluate climatic and vegetative data to analyze shifts in rangeland production to implement actions, if necessary, to ensure the long-term productivity of rangeland; and using certified noxious-weed-free vegetation products on all BLM-administered lands. Refer to Chapter 2 for goals, objectives and a complete list of management actions common to all alternatives for grassland and shrubland communities.

Alternative A

Surface Disturbance

Under Alternative A, approximately 105,805 acres of short-term and 13,771 acres of long-term surface disturbance is projected to occur in grassland and shrubland communities, based on the percent cover of these vegetation types in the Planning Area. Under Alternative A, impacts to grassland and shrubland communities associated with surface-disturbing activities would be primarily adverse. Short-term adverse impacts include soil erosion, loss of species diversity, and invasive species spread; however, the relatively small size of individual disturbed areas and the implementing BMPs would minimize these short-term impacts. Long-term impacts from development last longer than 5 years and primarily include a decrease in abundance and distribution of grasslands and shrublands. Table 4-8 lists the acreages of

grasslands and shrublands protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under Alternative A.

Routinely seeding, or requiring permittees and operators to seed, disturbed areas with native plant species would encourage native vegetation cover, maintain biological integrity, help shift vegetative communities toward DPC, and reduce the potential for the spread of invasive species. These would be beneficial impacts to grassland and shrubland communities. Conversely, seeding with only native species may reduce reclamation success compared to using the species most likely to restore vegetative cover, whether native or nonnative. Alternative A does not require a reclamation plan, the purpose of which is to incorporate measures to support the return of as much of the disturbed acreage to its predisturbed state as quickly as feasible upon conclusion of operations from a given surface pad. Not requiring comprehensive measures and monitoring to ensure the reclamation of areas following surface disturbance would result in a greater short-term adverse impact. However, reestablishing vegetation cover over disturbed soils within 5 years of initial seeding would encourage native vegetative structure and reduce long-term impacts associated with exposed soils (e.g., establishment and spread of invasive species). These would be beneficial impacts to grassland and shrubland communities.

Resource Uses

Under Alternative A, oil, gas, and other minerals development is project to result in 25,390 acres of short-term surface disturbance and 1,130 new oil and gas wells, a portion of which would adversely impact grassland and shrubland communities by contributing to a decline in their abundance, distribution, or health (Appendix T). Most of the Planning Area would remain open to mineral extraction. Alternative A makes available 4,033,195 acres for locatable mineral entry, which would involve long-term surface disturbance in the portion of that acreage where development occurs. Alternative A would result in impacts to grassland and shrubland communities from bentonite and gypsum development. Some of the impacts would be temporary during the life of the operation, with areas of disturbance reclaimed following closure of operations, but some areas may not reestablish pre-disturbance structure and density for more than 20 years.

Invasive species would adversely affect grassland and shrubland communities under Alternative A. The spread of invasive species reduces diversity in grasslands and shrublands and, in the case of cheatgrass spread, alters the fire regime so that fires burn frequently and rapidly. Under Alternative A, the BLM would perform vegetation treatments to control or eradicate invasive species on 2,000 acres. The projected surface disturbance from vegetative treatments under Alternative A would result in short-term adverse impacts, but would benefit grassland and shrubland communities over the long term.

Alternative A would involve the second-most acreage of surface disturbance from pipeline and road development. Pipeline disturbance would be short-term, because reclamation would return herbaceous cover to the disturbance areas following construction. However, grassland and shrublands in low precipitation zones may not return to pre-disturbance cover for more than 20 years. The amount of new road construction in grassland and shrubland communities would impact these areas proportionately through the loss of vegetation and potential spread of invasive species. New roads also would fragment grassland and shrubland communities, which may reduce species diversity.

Motorized vehicle use is limited to existing roads and trails in most of the Planning Area under Alternative A. Even when confined to roads, motorized vehicles increase the potential for invasive species spread and poorly designed or maintained roads may increase erosion and affect adjacent vegetation. Areas with grasslands and shrublands that allow OHV activities, but are further restricted by limiting use to designated roads and trails, include the Absaroka Mountain Foothills SRMA and Bighorn River SRMA. Alternative A allows OHV use in areas with limited travel designations for big game

retrieval and dispersed campsite access, which could result in road and trail proliferation that would damage vegetation and impact grasslands and shrublands. Areas where damage from off-road use is most likely include stream crossings, areas with highly erosive soils, steep slopes, areas with important biological soil crusts, and vegetative communities with plants, such as Wyoming big sagebrush, susceptible to physical damage. Motorized vehicle use under Alternative A would result in adverse impacts to grassland and shrubland communities.

Livestock grazing management under Alternative A would have both adverse and beneficial impacts to grassland and shrubland communities (see Table 4-8). Under Alternative A, the BLM emphasizes monitoring on category "I" allotments, treats monitoring on category "M" and "C" allotments as a low priority, and develops and implements AMPs as needed to meet multiple use objectives. By emphasizing monitoring only on higher priority allotments, undesirable conditions in lower priority allotments may not be identified and deterioration or improvement in grassland and shrubland communities may not be realized in a timely manner. However, concentrating monitoring on category "I" allotments would beneficially affect these allotments because undesirable conditions would be identified more quickly. When appropriately managed according to the *Wyoming Guidelines for Livestock Grazing Management* and other appropriate BMPs, livestock grazing would benefit grasslands and shrublands as described under Impacts Common to All Alternatives.

The BLM requires livestock flushing on a case-by-case basis, allowing for the potential spread of invasive species via livestock to grazed grassland and shrubland communities. However, identifying and flushing potential vector livestock would reduce the threat of invasive species spread in some instances. Rangeland improvements such as reservoirs, pits, pipelines, and wells would involve removing vegetation and may concentrate livestock and increase the potential spread of invasive species. Due to allotment monitoring practices, AMP development, livestock flushing practices, and projected rangeland improvements, livestock grazing under Alternative A would, overall, benefit grasslands and shrublands by continuing to improve these vegetation types in the Planning Area.

Special Designations

Special designations would benefit grasslands and shrublands where the designations protect areas from resource uses or activities that may damage or destroy vegetation or increase the potential for wildfire or invasive species spread. The primary purpose of the Carter Mountain ACEC designated under Alternative A is to protect grassland and shrubland communities. Protective buffers around the Nez Perce (Neeme-poo) NHT and other trails may protect areas of grasslands and shrublands from disturbance. Table 4-8 lists the acreages of grassland and shrubland communities in special designation areas; the designations would limit adverse impacts to these vegetation communities.

Resources

The vegetation treatments applied according to the fire and fuels management actions under Alternative A may be inadequate to reduce fuel conditions enough to substantially diminish the risk of catastrophic fire. Most the Planning Area is in FRCC Classes 2 and 3, which have the highest risk of catastrophic fire or of having lost or losing key ecosystem components (see Section 4.3 *Fire and Fuels Management*). Intense fires in areas where fuels exceed historical levels may destroy the seeds of perennial grasses and shrubs and alter soils to increase the risk of invasive species establishment. The BLM would apply most of the total projected prescribed fire and fuels treatment acreage under Alternative A (70,000 acres) to grassland and shrubland communities not meeting DPC objectives (Appendix T).

Under Alternative A, the BLM utilizes wildland fires to restore fire-adapted ecosystems and to reduce hazardous fuels. Alternative A would involve the second highest level of surface disturbance from prescribed fire and fuels treatments. Prescribed fire would cause a short-term adverse impact to grasslands and shrublands by destroying vegetation, increasing soil erosion, and increasing the potential spread of invasive species. However, the relatively small size of individual treatment areas and the use of BMPs would minimize these short-term impacts. Prescribed fire and fuels treatments would benefit grassland and shrubland communities in the long term by reducing fuels and preventing catastrophic fires. Overall, fire and fuels management under Alternative A would result in long-term beneficial impacts to shrubland and grassland communities.

Wildlife management actions under Alternative A would indirectly benefit grassland and shrubland communities. Alternative A prohibits domestic sheep grazing on pronghorn crucial winter range, unless adverse impacts can be avoided or mitigated, reducing the potential for increased herbivory that may shift shrubland communities to conifers, grasses, forbs, and annuals. Limiting surface-disturbing activities around greater sage-grouse leks and in winter, nesting, and early brood-rearing habitats would create short-term beneficial impacts to grassland and shrubland communities in these areas. However, if these restrictions prevent vegetation treatments that would improve grassland and shrubland health in the long term, they may adversely impact communities in these areas. The short-term beneficial impacts of preventing vegetation loss from surface disturbance may outweigh potential loss of long-term benefits from vegetation treatments.

Proactive Management

Alternative A would result in beneficial long-term impacts to grassland and shrubland health by managing grassland and shrubland communities on 600,000 acres of BLM-administered land toward DPC objectives for watershed protection and livestock grazing. Managing toward DPC objectives improves overall community health, improves plant vigor, reduces the potential for erosion, and improves forage for livestock and wildlife. This active management under Alternative A would benefit a limited portion of the 2,757,959 acres of grassland and shrubland on BLM-administered lands. Because the BLM implements these management actions on a portion of grassland and shrubland communities, Alternative A would create limited long-term beneficial impacts to grasslands and shrublands.

Alternative B

Surface Disturbance

Under Alternative B, approximately 55,256 acres of short-term and 9,538 acres of long-term surface disturbance is projected in grassland and shrubland communities, based on the percent cover of these vegetation types in the Planning Area. Impacts to grassland and shrubland communities associated with surface-disturbing activities would be the least under this alternative. Table 4-8 lists the acreages of grasslands and shrublands protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative.

Under Alternative B, the BLM analyzes surface-disturbing activities by mapping soils, collecting soil samples for physical and chemical analysis, and evaluating current erosion conditions. Alternative B requires that disturbed areas be reestablished with 50 percent of native vegetative cover within three growing seasons, and 80-percent cover within five growing seasons of initial seeding, based on preexisting conditions. Alternative B also manages disturbed areas to reestablish healthy native plant communities based on preexisting composition or other species, as identified in an approved management plan. Approving reclamation plans before all surface-disturbing activities under this alternative would minimize short-term adverse impacts by requiring project proponents to propose

comprehensive measures and monitoring to ensure reclamation of areas following surface disturbance. Reclamation practices under Alternative B increase the chance of successful reestablishment of grasslands and shrublands in disturbed areas. Based on management of reclamation and the amount of long-term disturbance acreage projected under Alternative B, this alternative would result in the least short- and long-term adverse (and greatest beneficial) impacts to grassland and shrubland communities.

Resource Uses

Under Alternative B, oil, gas, and other minerals development would result in 17,327 acres of short-term surface disturbance and 509 new oil and gas wells, resulting in impacts similar to those under Alternative A, but to a lesser degree (Appendix T). Alternative B leaves the least area available for locatable mineral entry (3,882,447 acres), which would result in the least long-term surface disturbance compared to the other alternatives. Some of the impacts would be temporary during the life of the operation, with areas of disturbance reclaimed following closure of operations.

Adverse impacts from invasive species would be similar to those under Alternative A, but to a lesser degree. Alternative B would involve the fewest acres of surface disturbance to control or eradicate invasive species. However, due to the projected overall surface disturbance, reclamation practices, and motorized vehicle use restrictions, Alternative B also would involve the smallest area vulnerable to invasive species establishment. Therefore, Alternative B would result in the fewest adverse impacts to grassland and shrubland communities from invasive species.

Alternative B would involve the least acreage of disturbance from pipeline and road development, and the greatest chance of successful reestablishment of grasses and shrubs following construction. Alternative B also would involve the least new road construction. Compared to the other alternatives, projected new roads under Alternative B and management designed to manage for large contiguous blocks of important plant communities along with managing more acreage as ROW avoidance/mitigation and exclusion areas would present the least potential for fragmentation of grasslands and shrublands and associated loss of diversity.

Motorized vehicle use under Alternative B would cause impacts to grasslands and shrublands similar to those under Alternative A, but to a lesser degree. Most of the Planning Area is limited to designated roads and trails, including areas in the West Slope and Badlands areas, limiting impacts to grasslands and shrublands from motorized vehicle use. Alternative B prohibits off-road motorized vehicle use for big game retrieval and dispersed campsites, which would reduce adverse impacts to grasslands and shrublands by preventing road and trail proliferation and vegetation damage. Alternative B would involve more long-term surface disturbance associated with the creation of new roads and trails for recreational purposes than Alternative A, but less than alternatives C and D (Appendix T), with proportional impacts to grasslands and shrublands from vegetation removal. Compared to other alternatives, Alternative B would result in the fewest adverse impacts to grassland and shrubland communities from motorized vehicle use.

Alternative B would result in the most extensive monitoring and grazing management to identify and improve grassland and shrubland conditions in a timely manner. Under Alternative B, the BLM monitors all allotments and develops or revises AMPs for all "I" allotments or allotments not meeting the *Wyoming Standards for Healthy Rangelands* (Appendix N). The authorized officer can require livestock flushing for up to 72 hours to reduce the threat of invasive species spread via livestock to grassland and shrubland communities. Alternative B would result in the least disturbance acreage from rangeland improvements such as reservoirs, pits, pipelines, and wells (Appendix T), posing the least threat to grasslands and shrublands from invasive species spread and livestock concentration. Conversely, decreasing surface-disturbing rangeland improvement activities may adversely affect some grassland

and shrubland communities where problems with livestock distribution cannot be addressed without these projects. Due to allotment monitoring practices, AMP development, livestock flushing practices, and projected rangeland improvements, livestock grazing management under Alternative B would result in the least adverse and most beneficial impacts to grasslands and shrublands.

Under Alternative B, the BLM closes greater sage-grouse Key Habitat Areas and elk and bighorn sheep crucial winter range to livestock grazing (Table 4-8). This management would have a beneficial impact on some grasslands and shrublands by increasing vegetation cover and reducing the chance of soil compaction and invasive species spread. However, a recent land management modeling effort over large areas in eastern Nevada concluded that the proposed removal of livestock grazing alone had little impact on vegetation resiliency, rather, active restoration (e.g., prescribed fire, mechanical and chemical treatments) was required to improve degraded habitats (Provencher et al. 2007). Other research indicates removing grazing will increase woody plant cover and may reduce species richness and diversity (Manier and Hobbs 2007). Any beneficial impacts to grasslands and shrublands in greater sage-grouse Key Habitat Areas and bighorn sheep crucial winter range from the removal of livestock grazing may, therefore, be limited. The removal of livestock grazing would also mean that any beneficial impacts to these areas that would result from properly managed livestock grazing under Alternative A, such as increased resilience to disturbance and removal of decadent vegetation, would not be realized under Alternative B.

Special Designations

Proposed special designations to protect grassland and shrubland communities under Alternative B include the Carter Mountain (existing and expansion areas), Little Mountain (expansion area), Clarks Fork Canyon, Chapman Bench, Rattlesnake Mountain, and Sheep Mountain ACECs. Under Alternative B, the BLM would designate all LWCs as Wild Lands and manage them to protect their naturalness and primitive recreation, and restrict resource uses and activities in these areas that may damage grassland and shrubland vegetation. Alternative B applies the largest buffer around the Heart Mountain Relocation Center National Historic Landmark and the Nez Perce (Neeme-poo) NHT to restrict surface-disturbing activities and motorized vehicle use, which would benefit grassland and shrubland communities in these areas. Table 4-8 lists the acreages of grassland and shrubland communities in special designation areas under Alternative B.

Resources

Under Alternative B, the BLM utilizes wildland fires and other vegetation treatments to restore fire-adapted ecosystems and to reduce hazardous fuels. However, Alternative B would result in the least acreage of prescribed fire and fuels treatments (25,000 acres), and therefore the greatest risk of inadequate fuel reductions to substantially reduce the risk of catastrophic fire (Appendix T). This alternative would result in the least long-term beneficial impact from preventing fire that may destroy and permanently alter grassland and shrubland communities, compared to the other alternatives.

Wildlife management actions under Alternative B would indirectly benefit grassland and shrubland communities the most. Alternative B prohibits all new domestic sheep grazing on pronghorn crucial winter range, reducing the potential for overgrazing due to dietary overlap of the two species more than Alternative A. Under Alternative B, the Absaroka Front Management Area, to which the BLM does not apply specific management actions under Alternative A, restricts some resource uses (e.g., mineral leasing and motorized vehicle use) that would remove vegetation or damage grassland and shrubland health on the 56,220 acres of this plant community type in its boundaries. Compared to the other alternatives, Alternative B limits surface disturbance around greater sage-grouse leks and in winter, nesting, and early brood-rearing habitats the most, which would result in a greater beneficial impact.

However, Alternative B may also result in the least long-term beneficial impact in these areas by restricting vegetation treatments in areas where the plant community is extremely degraded, especially by the occurrence of noxious weeds, or by the increase in certain conifer species (e.g., juniper). The short-term beneficial impacts of preventing vegetation loss from surface disturbance may outweigh potential loss of long-term benefits from vegetation treatments where they are necessary to restore degraded vegetation communities.

Proactive Management

Under Alternative B, the BLM manages to achieve or make progress toward achieving 75 percent or more of Historical Climax Plant Community in all grasslands and shrublands, benefitting these communities by making progress toward improving vegetation conditions. The BLM would also manage to maintain large contiguous blocks of native plant communities, which would result in beneficial impacts to grassland and shrubland communities; however, Alternative B would result in the least acreage of vegetation treatments to improve vegetation conditions (Appendix T).

Alternative C

Surface Disturbance

Under Alternative C, approximately 179,027 acres of short-term and 36,417 acres of long-term surface disturbance is projected in grassland and shrubland communities, based on the percent cover of these vegetation types in the Planning Area. Under Alternative C, the impacts to grassland and shrubland communities associated with surface-disturbing activity is more than any other alternative. Table 4-8 lists the acreages of grasslands and shrublands protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative.

Under Alternative C, the BLM analyzes surface-disturbing activities by mapping soils, collecting soil samples for physical and chemical analysis, and evaluating current erosion conditions on a case-by-case basis. Alternative C requires that disturbed areas are reestablished with 30 percent of desired vegetative cover within three growing seasons (with no long-term cover requirement) and requires reclamation plans on a case-by-case basis, which would result in a greater beneficial impact from stabilizing soil than Alternative A, but less than alternatives B and D. Allowing the use of approved nonnative seed and reestablishing plant communities to increase commodity production in disturbed areas may result in more immediate soil stabilization in the short term (depending on the species used) than Alternative A, but would also adversely impact disturbed areas by reducing the potential for reestablishing native plant communities in the long term. Based on the reclamation actions under Alternative C and the amount of long-term disturbance acreage projected, this alternative would result in the greatest adverse (and least beneficial) short- and long-term impacts to grassland and shrubland communities.

Resource Uses

Under Alternative C, oil and gas and other minerals development would result in 25,771 acres of short-term surface disturbance and 1,257 new oil and gas wells, resulting in impacts similar to those under Alternative A, but to a greater degree (Appendix T). Locatable minerals development under Alternative C would result in similar long-term surface disturbance and associated impacts as those under Alternative A. Overall, minerals development under Alternative C would result in the greatest adverse impacts to grassland and shrubland communities.

Adverse impacts from invasive species would be similar to those under Alternative A, but to a greater degree. Alternative C would result in the most acres of invasive species control or eradication activities.

However, Alternative C would also leave the largest area vulnerable to new invasive species establishment due to new surface disturbance (245,783 acres), less rigorous reclamation requirements, and the least restrictive management of motorized vehicle use. Based on these factors, Alternative C would result in the greatest adverse impacts to grassland and shrubland communities from invasive species, relative to the other alternatives.

Alternative C would result in the greatest acreage of disturbance from pipeline and road development and the smallest chance of successful reestablishment of grasses and shrubs following construction. Alternative C also would result in the most new road construction. The projected new roads under Alternative C would result in the greatest potential for fragmentation of grasslands and shrublands and the associated loss of species diversity relative to the other alternatives, particularly since this alternative does not, like Alternative B, manage for large contiguous blocks of important plant communities and manages less acreage as ROW avoidance/mitigation and exclusion areas.

Motorized vehicle use under Alternative C would result in impacts to grasslands and shrublands similar to those under Alternative A, but to a greater degree. Alternative C limits motorized vehicle use to designated roads and trails in more area than Alternative A, but closes less area. Under Alternative C, the BLM also limits motorized vehicle use to designated roads and trails with seasonal closures in the Absaroka Front Management Area, which encompasses 56,220 acres of grasslands and shrublands. Under Alternative C, BLM actions would result in the most long-term surface disturbance from motorized vehicle use, of which a portion would directly impact grasslands and shrublands by removing vegetation. Allowing off-road motorized vehicle use for big game retrieval and dispersed campsites as long as there is no resource damage would put grassland and shrubland communities at greater risk of adverse impacts than Alternative B in this regard. Overall, Alternative C would result in the greatest adverse impacts to grassland and shrubland communities from motorized vehicle use, compared to the other alternatives.

Under Alternative C, the BLM varies the intensity of allotment monitoring, giving priority to category "I" allotments and those not meeting the *Wyoming Standards for Healthy Rangelands* (Appendix N). By emphasizing monitoring only on higher priority allotments, undesirable conditions in lower priority allotments may not be identified and deterioration or improvement in grassland and shrubland communities may not be realized in a timely manner. Not requiring livestock flushing would result in the greatest risk of invasive species spread to grasslands and shrublands via livestock. Alternative C would result in the most disturbance acreage from rangeland improvements such as reservoirs, pits, pipelines, and wells (Appendix T), posing the greatest threat from invasive species spread—exacerbated due to the lack of livestock flushing—and livestock concentration. Conversely, this alternative has the greatest potential to address some improper livestock distribution-related concentrated herbivory issues that require rangeland improvement projects and, therefore, the beneficial impacts from properly managed livestock grazing, described under Impacts Common to All Alternatives, would also be greatest under this alternative. Under this alternative, the BLM does not manage livestock grazing to enhance other resource values; the BLM would manage grasslands and shrublands at a lower seral stage to increase herbaceous forage production. Potential adverse impacts to grasslands and shrublands from allotment monitoring and grazing management practices, livestock flushing practices, and surface disturbance from projected rangeland improvements would outweigh the potential beneficial impacts from livestock grazing management. Overall, livestock grazing management would result in the greatest adverse impacts to grassland and shrubland communities under Alternative C.

Special Designations

No ACECs, specific to Alternative C, would protect substantial amounts of grasslands and shrublands. Protective buffers around the Nez Perce (Neeme-poo) NHT and Other Historic Trails, of similar size to Alternative A, may protect areas of grasslands and shrublands from disturbance. The BLM also applies a protective buffer around the Heart Mountain Relocation Center National Historic Landmark under this alternative. Table 4-8 lists the acreages of grassland and shrubland communities in special designation areas under Alternative C.

Resources

Under Alternative C, the BLM utilizes wildland fires and other vegetation treatments to restore fire-adapted ecosystems, reduce hazardous fuels, and enhance forage for commodity production. Alternative C would result in the most acreage of prescribed fire and fuels treatments (140,000 acres), and therefore the highest probability of adequate fuel reductions to substantially reduce the risk of catastrophic fire (Appendix T). This alternative would result in the most long-term beneficial impact from preventing fire that may destroy and permanently alter grassland and shrubland communities, compared to the other alternatives.

Wildlife management actions under Alternative C would indirectly benefit grassland and shrubland communities the least. Alternative C allows domestic sheep grazing on pronghorn crucial winter range, increasing the potential for overgrazing. Alternative C would allow more resource uses (e.g., oil, gas, and other mineral leasing) in the Absaroka Front Management Area that may result in more adverse impacts to the 56,312 acres of grasslands and shrublands in its boundaries than under Alternative B. Compared to the other alternatives, Alternative C applies the least surface-disturbance restrictions around greater sage-grouse leks and in nesting and early brood-rearing habitats, does not apply restrictions in winter concentration areas, and exempts Oil and Gas Management Areas from discretionary wildlife seasonal stipulations. These management actions would result in the least short-term beneficial impacts by preventing vegetation removal or degradation in these areas, compared to the other alternatives. However, Alternative C allows vegetation treatments over a greater area than the other alternatives, providing a long-term benefit by reducing fuel loads. The short-term adverse impacts of vegetation loss from surface disturbance may outweigh potential long-term benefits from vegetation treatments.

Proactive Management

Under Alternative C, the BLM manages to achieve or make progress toward achieving the *Wyoming Standards for Healthy Rangelands* (Appendix N) for all grasslands and shrublands. Alternative C would result in the most acreage of vegetation treatments to improve vegetation conditions (Appendix T); however, no grasslands and shrublands are managed toward DPC. Alternative C would result in the fewest beneficial impacts from proactive management toward achieving historical community structure and composition. However, the projected area of prescribed burns and vegetation treatments under Alternative C would result in beneficial impacts across the greatest area to achieve rangeland health standards, relative to the other alternatives, in areas needing active restoration due to substantial habitat degradation.

Alternative D

Surface Disturbance

Under Alternative D, approximately 106,997 acres of short-term and 16,166 acres of long-term surface disturbance is projected in grassland and shrubland communities, based on the percent cover of these

vegetation types in the Planning Area. Although the BLM projects that Alternative D would result in slightly more surface disturbance than Alternative A, more stringent reclamation and restoration practices may result in fewer long-term adverse impacts from surface disturbance. Table 4-8 lists the acreages of grasslands and shrublands protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative.

The reclamation and restoration practices under Alternative D would result in similar beneficial impacts to those under Alternative A, but to a greater degree. Incorporating erosion rates and soil stability into soil survey efforts, developing specific objectives and timeframes for reclamation plans in coordination with stakeholders, and beginning interim and final reclamation at the earliest feasible time would result in greater beneficial impacts than alternatives A and C, but less than Alternative B.

Resource Uses

Under Alternative D, oil, gas, and other minerals development would result in 24,896 acres of short-term surface disturbance and 1,032 new oil and gas wells, affecting grassland and shrubland communities similar to Alternative A. Locatable minerals development under Alternative D would result in long-term impacts to grasslands and shrublands similar to those under Alternative A. Alternative D closes the second least area in grasslands and shrublands to locatable minerals development and may result in more adverse impacts from long-term surface disturbance than Alternative A. However, the demand for locatable minerals entry, and therefore the level of development and impact, would be similar under all alternatives.

Adverse impacts from invasive species would be similar to those under Alternative A, but to a lesser degree. Alternative D controls or eradicates invasive species on the same amount of land as Alternative A and surface disturbance under Alternative D would leave a similar amount of land vulnerable to invasive species spread. However, the more rigorous reclamation requirements and restrictive management of motorized vehicle use would limit the establishment and spread of invasive species more than Alternative A.

ROW development under Alternative D, including roads and pipelines, would result in impacts similar to those under Alternative A, but to a lesser degree because managing more acreage as ROW avoidance/mitigation or exclusion areas would limit habitat fragmentation more than ROW management under alternatives A and C.

Motorized vehicle use under Alternative D would result in adverse impacts similar to those under Alternative A, but to a lesser degree. Alternative D closes slightly more area to motorized vehicle use than Alternative A, limits motorized vehicle use to designated roads and trails in more area and restricts off-road motorized vehicle use for big game retrieval to within 300 feet of established roads, resulting in less adverse impacts to grasslands and shrublands than alternatives A and C, but more than Alternative B.

Livestock grazing management under Alternative D would result in adverse impacts to grasslands and shrublands similar to Alternative A. However, allowing livestock grazing in areas closed to grazing as a tool to maintain or improve resource conditions may result in more beneficial impacts.

Special Designations

Proposed special designations that would protect grassland and shrubland communities under Alternative D include the Carter Mountain, Little Mountain, Clarks Fork Canyon, and Sheep Mountain ACECs. In addition, the Craig Thomas Little Mountain SMA, Chapman Bench Management Area, and 52,485 acres designated as Wild Lands would limit resource uses and activities that can adversely affect

grassland and shrubland communities. Special designations under Alternative D would result in more beneficial impacts to grasslands and shrublands than alternatives A and C, but less than Alternative B.

Resources

Fire and fuels management practices and the area treated to reduce fuels under Alternative D would result in impacts similar to those under Alternative A.

Wildlife management actions under Alternative D would result in similar beneficial impacts as those under Alternative A, but to a greater degree. Alternative D prohibits sheep grazing on pronghorn crucial winter range, restricts resource uses in the Absaroka Front Management area, and restricts surface-disturbing activities around greater sage-grouse leks and in winter, nesting, and early brood-rearing habitats more than Alternative A. Restricting surface-disturbing activities may limit vegetation treatments in areas needing restoration where the plant community is extremely degraded; however, the short-term beneficial impacts of preventing vegetation loss from surface disturbance may outweigh potential loss of long-term benefits from vegetation treatments. Overall, wildlife management would result in more indirect beneficial impacts than alternatives A and C, but less than Alternative B.

Proactive Management

Proactive management under Alternative D would result in similar beneficial impacts as those under Alternative B, but to a lesser degree. Under Alternative D, the BLM would manage to maintain large contiguous blocks of native plant communities, similar to Alternative B, but would manage grassland and shrubland communities toward achieving 65 percent of Historical Climax Plant Community, compared to 75 percent under Alternative B.

4.4.3 Vegetation – Riparian/Wetland Resources

An impact to riparian/wetland resources alters the physical, chemical or biological components of the ecosystem. Actions that contribute to the decline in abundance, distribution, or functionality of riparian/wetland resources would be adverse impacts. Conversely, beneficial impacts result from management actions that protect or restore riparian/wetland resources in the Planning Area.

Direct impacts to riparian/wetland resources result from disturbing vegetation or ground surface in these communities. Indirect impacts to riparian/wetland communities result from actions in a watershed that cause a change in riparian/wetland functionality (e.g., increased rates of sediment loading or changes in hydrology), a change in water chemistry, or spread of invasive species. Short-term impacts occur in the 5 years following the disturbance and include increased sediment loading into streams and the potential spread of invasive species. Long-term impacts last longer than 5 years and primarily include loss of habitat due to development or other activities that degrade riparian/wetland resources (e.g., permanently altering stream morphology and associated vegetation).

4.4.3.1 Methods and Assumptions

Evaluating potential impacts to riparian/wetland areas caused by changes in functionality or invasive species establishment focuses on resource management actions that (1) cause surface disturbances or limit the impacts for surface disturbances, and (2) are substantially different among the proposed alternatives. Estimates of projected surface disturbances are used as the primary metric for determining the relative level of potential indirect impact to riparian/wetland areas.

Methods and assumptions used in this impact analysis include the following:

- Surface disturbances generally increase the potential for accelerated sediment loading to streams.
- Surface disturbances generally increase surface runoff to streams due to an increase in impervious surface, changes in water routing, and loss of vegetation.
- Surface disturbance, transportation networks, ungulate use, and recreation increase the likelihood of invasive species introduction and spread in an area.
- The greater the amount of surface disturbance in a watershed, the greater the probability that excess surface runoff and sediment will enter the stream and contribute to the loss of riparian/wetland functionality.
- Placing salt and mineral supplements outside of riparian/wetland communities is one tool that can reduce wildlife and livestock use of riparian/wetland areas.
- Surface runoff to streams generally increases as livestock stocking rates increase. This is not a linear relationship. For example, low stocking rates typically have no measurable impact on surface runoff, moderate stocking rates typically have a negligible impact on surface runoff, high stocking rates have a measurable impact on surface runoff, and consecutive years of high stocking rates have the highest potential for increasing surface runoff to streams.
- Herbivory use is typically disproportionately higher in riparian/wetland communities than in upland communities. Improper or unmanaged herbivory can adversely impact these areas throughout the year, but surface impacts (due to hoof action) are generally greater in the spring and early summer, when soils are wet and, therefore, more vulnerable to compaction and stream banks are more vulnerable to sloughing. Livestock, especially cattle, tend to congregate in these communities during the hot season (mid to late summer). While stocking rates for an allotment or pasture may be low to moderate, the utilization levels in riparian/wetland areas can be high.
- Riparian areas are evaluated during application of the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N).
- Grazing practices can maintain, improve, or degrade rangeland health. The *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N) are designed to maintain or improve rangeland health. Approximately 10 percent of the public land in the Planning Area is evaluated annually for rangeland health.
- Riparian/wetland areas, except for laterally unstable cobble substrate-based streams, possess the ability to recharge and rebound faster than other vegetative areas in the Planning Area.
- All riparian/wetland areas are evaluated per the *Wyoming Standards for Healthy Rangelands* (Appendix N) and managed toward proper functioning condition (PFC). Management toward DPC is assumed to exceed the requirements of managing toward desired future condition (DFC), which is assumed to exceed the requirements of managing toward PFC.

4.4.3.2 Summary of Impacts by Alternative

Adverse impacts to riparian/wetland resources arise from surface-disturbing and other activities that increase erosion and sediment loading into surface waterbodies and degrade vegetation health. Major sources of these impacts include mineral resources development, motorized vehicle use, road

construction, and wild horse and unsuitable livestock grazing management. Alternative C would result in the greatest projected total surface disturbance, followed by alternatives D, A, and B. Surface disturbance is anticipated to result in proportional levels of erosion and sedimentation, and as such, impacts to riparian/wetland resources are expected to be greatest under Alternative C, the least under Alternative B, and similar under alternatives A and D. Alternative B would result in the greatest direct beneficial impact to riparian/wetland resources by imposing greater restrictions on surface-disturbing activities in proximity to riparian/wetland resources and by instituting more beneficial proactive management actions such as watershed improvement projects, followed by alternatives D, A, and C. Alternative B and alternatives A and D prohibit livestock forage supplements within ½ and ¼ mile of riparian/wetland resources, respectively, to prevent vegetation degradation and soil compaction in these areas; Alternative C does not. Overall, Alternative B would result in the fewest adverse impacts to riparian/wetland resources, followed by alternatives D, A, and C.

4.4.3.3 Detailed Analysis of Alternatives

Allowable uses and management actions that may impact riparian/wetland resources include surface-disturbing activities, motorized vehicle use, recreation, livestock grazing, and proactive management actions. Impacts to soil and water, which may impact riparian/wetland resources, are discussed in Section 4.1.3 *Soil* and Section 4.1.4 *Water*.

Impacts Common to All Alternatives

The types of potential impacts to riparian/wetland resources are similar under all alternatives. However, the intensity of impacts would vary by alternative, as described for each.

Implementing any of the alternatives may cause direct and indirect impacts to riparian/wetland resources. Because riparian/wetland areas are limited and often the most productive lands, they are disproportionately affected by humans, livestock, wild horses, and wildlife, compared with the same types or extent of actions in upland areas. The BLM generally avoids, whenever possible, direct impacts to riparian/wetland areas under all alternatives and minimizes impacts from projects or resource uses that involve riparian areas through applying BMPs. In addition, the BLM manages lotic and lentic riparian/wetland areas to meet PFC and the *Wyoming Standards for Healthy Rangelands* (Appendix N).

Riparian vegetation is more susceptible to grazing impacts during the spring, when soils are wet and more vulnerable to compaction, and during the hot season (July and early August), as livestock is naturally attracted to areas with water and thermal cover. Many grazing management strategies, such as rotation, deferment, rest from use, and the manipulation of season of use and grazing intensity would be implemented to manage vegetation composition, cover, and vigor to maintain or achieve PFC in riparian areas. As the BLM does not practice wild horse relocation in HMAs, year-round wild horse grazing may adversely impact, unless fenced, riparian areas in HMAs and impair the ability to maintain or achieve PFC in these areas.

Changes in water chemistry can affect riparian/wetland areas primarily through changes in plant species composition, which may affect utilization of the area by wildlife and livestock. Indirect impacts caused by changes in water chemistry have not been a major factor in the Planning Area historically and are not expected to be in the future. Impacts caused by wildlife are generally less than those caused by livestock, particularly cattle and wild horses in operational HMAs. As is the case with livestock, wildlife also is attracted to and often congregates in wetland areas; however, the size and foraging habitat of wildlife limits adverse impacts. In localized areas, elk have affected riparian habitats through trampling, wallowing, and grazing. Likewise, the impacts associated with wild horse management activities would

be similar to those described for livestock grazing, except localized to the 4,570 acres of riparian/wetlands in existing HMAs.

The management of special status species generally involves restricting activities in the vicinity of special status plants or wildlife either year-round or during specific times of the year. As a result, riparian/ wetland areas in the vicinity of buffer zones of special status species can benefit from the lower level of public use. In addition, efforts at conserving species, such the Ute ladies'-tresses (a wetland species), can directly benefit riparian condition.

Alternative A

Surface Disturbance

Based on the percent cover of this vegetation type and the total projected surface disturbance (Table 4-1), there may be 910 acres of short-term and 118 acres of long-term surface disturbance in riparian/ wetland areas on BLM-administered surface under Alternative A. However, prohibiting surface-disturbing activities within 500 feet of surface water and riparian/wetland areas unless impacts can be mitigated would reduce the acreage of surface disturbance in these areas. Therefore, the principle impacts to riparian/wetland resources associated with surface-disturbing activities would be indirect impacts. Indirect adverse impacts to riparian/wetland resources would be associated with surface-disturbing activities in the watershed. Short-term impacts include increased sediment loading into streams and the potential spread of invasive species. Long-term impacts include loss of habitat due to development. As a summary, Table 4-8 lists the acreages of riparian/wetland areas protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative.

While most surface-disturbing activity will not be near riparian/wetland areas, these areas may be indirectly impacted due to soil erosion in the uplands, which may increase sediment released into streams. Alternative A would result in short-term and long-term soil erosion rates of approximately 568,166 and 25,167 tons per year, respectively that may adversely affect riparian/wetland resources (see Section 4.1.3 *Soil*). Higher sediment loading to a stream may dramatically alter its form and, consequently, the integrity of the riparian/wetland resources adjacent to it. The impact of increased sediment loading depends on the stream's ability to pass the sediment through the system and largely depends on the size (i.e., discharge volume) of the stream and the channel slope gradient. In segments of a stream that have lower gradients, deposition occurs and the stream channel aggrades (builds), possibly becoming braided and shallow. In some instances, the aggradations of the streambed may cause the stream to down cut or degrade (become more incised) as the stream seeks to restore its equilibrium. The additional material eroded from the upstream channel is transported down to a depositional area and the cycle continues. In such cases, the functionality of the riparian/wetland areas in both the aggraded stream reach, and the incised stream reach, change.

Resource Uses

Most of the Planning Area remains open to mineral extraction under Alternative A; the associated surface disturbance would be the second highest of the alternatives. While the BLM prohibits surface-disturbing activity associated with mineral development within 500 feet of riparian/wetlands, this type of activity in the uplands, including well pad construction, pipeline development, and road construction, may increase sediment loading in streams. Under Alternative A, the BLM allows the surface discharge of produced water if it meets state of Wyoming water quality standards. Water production from oil and gas development represents a new water source in a watershed that augments existing water flows. In the event that produced water from CBNG or traditional gas development is disposed of on the surface,

riparian/wetland vegetation may be affected. Impacts may be both beneficial (e.g., increased water quantity that may benefit riparian/wetland vegetation or create new riparian/wetland areas) and detrimental (e.g., increased dissolved compounds and water temperature that may adversely impact riparian/wetland vegetation), as discussed in more detail in Section 4.1.4 *Water*.

Invasive species are particularly undesirable in riparian/wetland areas because they do not have the same high level of soil-binding properties that many native riparian/wetland species (e.g., willows and sedges) have. The proximity of surface disturbances to riparian/wetland areas is one of the primary ways in which invasive species would spread to these areas. Prohibiting surface disturbance within 500 feet of riparian/wetland areas would help reduce the opportunity to spread invasive species to these areas. Invasive species and pest management under Alternative A includes allowing aerial application of pesticides and requiring livestock flushing on a case-by-case basis. Application of chemicals near water may reduce water quality, adversely affecting the health of riparian/wetland resources. Requiring livestock flushing would reduce the opportunity of spreading ingested invasive species seeds or material to riparian/wetland areas.

One of the most prevalent increases in surface runoff caused by human activity is due to an increase in impervious cover (e.g., roads, parking lots, and rooftops). Roads are not only impervious, they also route water. While small increases in surface runoff may have a beneficial impact on riparian/wetland areas because more water may be available for plant growth, they may also cause an increase in channel incision. Channel incision could disconnect the stream from its floodplain (i.e., gully formation) and, if the stream becomes incised enough, alter conditions in associated riparian/wetland areas. For this reason, it is undesirable to have a road close to a stream or crossings where runoff from the road is more likely to reach the stream.

Alternative A permits motorized vehicle use on existing roads and trails across the largest area but would result in the least acres of surface disturbance associated with new road and trail creation, compared to the other alternatives. However, Alternative A allows the use of off-road motorized vehicles to retrieve big game and to access dispersed campsites, which may cause undue environmental degradation and accelerated soil erosion in riparian/wetland areas. Motorized vehicle use and the associated greater access that it grants to recreationists, may adversely impact riparian/wetland resources by introducing invasive species near streams or wetlands and increasing erosion and sediment loading in streams. Recreational activities, such as camping, often occur near riparian/wetland areas and may result in adverse impacts through soil compaction and trash accumulation in or near these areas. More developed recreation areas would increase this potential, although most impacts are expected to be mitigated by managing recreational use to maintain or improve riparian/wetland resource conditions along intensively used streams and reservoirs. Recreation management areas such as SRMAs that restrict surface disturbance in these areas would have a beneficial impact on riparian/wetland resources.

Most of the Planning Area remains open to livestock grazing under this alternative. Concentrated livestock, wild horse, or wildlife grazing would increase runoff in a watershed due to soil compaction and loss of vegetative cover, with the amount of bare ground being the primary factor. Alternative A prohibits the placement of salt, mineral, or forage supplements within ¼ mile of water, wetlands, and riparian areas, which limits the direct impacts from livestock grazing on these areas. Livestock range improvement projects would distribute livestock over a large landscape, but would also create concentrated use in local areas. Over the long term, these improvements would potentially improve the stability and resiliency of riparian/wetland resources.

Special Designations

Special designations would result in beneficial impacts to riparian/wetland areas when they place additional restrictions on activities that degrade watershed health (e.g., surface-disturbing activities and motorized vehicle use). These restrictions have an indirect beneficial impact on riparian/wetland areas because these areas are not subject to large-scale surface-disturbing activities. Table 4-8 lists the acreage of wetlands in each type of special designation under Alternative A and Section 4.1.4 *Water* lists the miles of streams within special designations.

Resources

Implementing watershed improvement practices in Wyoming's Bighorn Basin water quality plans to reduce sediment loadings in streams and river segments and, when approved, including them in various BLM activity plans and use authorizations would benefit riparian/wetland resources.

Under Alternative A, the BLM utilizes wildland fires to restore fire-adapted ecosystems and to reduce hazardous fuels. The loss of vegetative cover from both wildland fires and prescribed fires would increase runoff and sediment to streams and other waterbodies in the short term. A rainstorm following a fire may overwhelm downstream waterbodies by contributing excessive amounts of sediment, large woody debris, and water to the system in a short period. Fires that burn more intensely would cause more adverse impacts to the watershed. Fires of the appropriate intensity generate a vegetation response that may have beneficial impacts on a watershed by helping to recharge water tables and increasing the amount of herbaceous cover, thereby improving livestock, wild horse, and wildlife distribution and lessening erosion.

Management actions under Alternative A designed to protect wildlife and special status species habitat from the impacts of surface-disturbing and disruptive activities will also protect riparian/wetland resources from these activities. For example, applying NSO and CSU restrictions in crucial wildlife habitat would reduce the chance of sediment loading into streams in these areas. Other beneficial impacts include performing restoration of streams and fisheries habitat on a case-by-case basis, which would have direct beneficial impacts on riparian/wetlands areas.

Proactive Management

Proactive management under Alternative A primarily consists of managing riparian/wetland areas to meet PFC and prohibiting surface-disturbing activities within 500 feet of surface water and riparian/wetland areas. This 500-foot buffer would prohibit surface-disturbing activities on 55,586 acres of BLM-administered land adjoining riparian/wetland areas. Management actions that strive to improve streams and conserve riparian/wetland areas generally result in long-term beneficial impacts to riparian/wetland resources. Watershed improvement projects, while potentially causing short-term impacts from surface disturbance, would result in long-term benefits to these areas by reducing sediment loading, improving stream conditions, and facilitating PFC, DFC, or DPC management objectives.

Alternative B

Surface Disturbance

The impacts to riparian/wetland resources under Alternative B from surface-disturbing activities would be similar to those under Alternative A, but to a lesser degree. Alternative B prohibits surface-disturbing activities within ¼ mile of all riparian/wetland areas, the largest buffer of all alternatives; therefore, the principle impacts from surface disturbance would be indirect. Alternative B also includes the greatest

restrictions on surface-disturbing activities for the protection of other resources such as for special designations, crucial winter range, and recreation management areas. Across the Planning Area, the BLM projects that this alternative would involve the smallest acreage of surface disturbance (Table 4-1), which would result in the least impact to riparian/wetland resources. Alternative B is projected to result in the least amount of short-term and long-term erosion (approximately 30 percent less than Alternative A), which would result in the least potential adverse impacts to riparian/wetland resources compared to the other alternatives (see Section 4.1.3 *Soil*). As a summary, Table 4-8 lists the acreages of riparian/wetland areas protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative.

Resource Uses

The projected amount of surface disturbance associated with mineral development under Alternative B is the lowest of the alternatives. Most of the impacts would be temporary during the life of the operation, with most areas of disturbance reclaimed following closure of operations; however, in the short term, mineral extraction activities would increase the potential for riparian/wetland health degradation. Activities such as well pad and road construction would increase runoff and sediment loading in streams. Alternative B prohibits the surface discharge of produced water on BLM-administered surface, negating the impacts (both beneficial and adverse) present under Alternative A.

The smaller amount of surface disturbance under Alternative B, compared to the other alternatives, will result in the least impact associated with invasive species in riparian/wetlands due to surface-disturbing activities. Alternative B prohibits aerial application of pesticides within ½ mile of riparian/wetland resources but allows exceptions to manage riparian weed species, a beneficial impact. Alternative B allows the authorized officer to require livestock flushing before allowing livestock to move onto or within BLM-administered land. Similar to Alternative A, discretionary livestock flushing will limit the risk of spreading invasive species to riparian/wetland areas from ingested seeds or material.

Alternative B would result in the least short- and long-term surface disturbance from new road creation associated with ROW development in the Planning Area, and therefore the fewest adverse impacts as described under Alternative A.

Alternative B permits motorized vehicle use on existing roads and trails in the smallest area and would result in the second-fewest acres of surface disturbance associated with the creation of new roads and trails for recreational purposes, after Alternative A. Limiting motorized vehicle use to designated roads and trails would limit public access and reduce the associated potential impacts to riparian/wetland areas, described under Alternative A. Alternative B also closes the largest area to motorized vehicle use compared to other alternatives. Off-road motorized vehicle use to retrieve big game and access dispersed campsites is prohibited in areas with limited travel designations and would limit erosion and sediment loading from trail proliferation near riparian/wetland areas. Alternative B places less emphasis on developing camping or recreation sites, reducing the potential for adverse impacts associated with concentrated recreational activities.

Livestock grazing management is more restrictive under Alternative B and more area is closed to grazing compared to the other alternatives. A ½-mile buffer prohibiting the placement of salt, mineral, or forage supplements near water, wetlands, and riparian areas, would provide greater protection for these resources from livestock and native ungulate grazing. Alternative B would result in fewer livestock improvement projects than other alternatives. While this would limit disturbance associated with these activities in the short term, riparian/wetland areas would not receive the long-term benefits of these improvement projects. For example, fewer water development projects may increase herbivory in

riparian/wetland areas because livestock, wild horses, and wildlife concentrate near natural water sources.

Special Designations

Compared to all other alternatives, Alternative B proposes more special designations containing riparian/wetland habitat (see Table 4-8 and Section 4.1.4 *Water*) and places more restrictions on surface-disturbing activities in these special designation areas. Prohibitions on surface-disturbing activities would limit adverse impacts to riparian/wetland resources in these areas.

Resources

Developing watershed improvement practices in cooperation with local governments to reduce sediment loading in stream and river systems and, once developed, including them in all activity plans and permitted activities would beneficially impact riparian/wetland resources.

Under Alternative B, the BLM utilizes wildland fires to restore fire-adapted ecosystems for natural resource systems and to reduce hazardous fuels. This utilization of wildland fire under Alternative B would result in impacts similar to those under Alternative A, but over less area. Therefore, under Alternative B, long-term beneficial impacts from prescribed fire would be less extensive than under the other alternatives.

Management actions designed to protect wildlife and special status species habitat apply greater restrictions on surface-disturbing activities than the other alternatives and therefore have a greater beneficial impact on riparian/wetland resources. Riparian/wetland areas in the Absaroka Front Management Area (444 acres), not identified under Alternative A, would benefit from the restrictions on some resource uses (e.g., mineral leasing and motorized vehicle use). Management actions designed to improve fisheries would also have a greater beneficial impact under Alternative B. The BLM would restore or reclaim important fisheries habitat through upland management and hydrologic function enhancement actions on at least 3 miles of lotic stream system. These restoration activities would result in beneficial impacts to riparian/wetland resources.

Proactive Management

Proactive management under Alternative B results in greater benefits to riparian/wetland resources than Alternative A. Alternative B manages riparian/wetland areas to meet DPC and prioritizes those riparian/wetland areas not meeting PFC. Management toward DPC is assumed to exceed the requirements of managing toward PFC and would therefore result in improved functioning and healthier riparian/wetland areas. As noted above, Alternative B prohibits surface-disturbing activities within ¼ mile of all riparian/wetland areas. This is the largest buffer of any alternative and would prohibit surface-disturbing activities on 140,464 acres of BLM-administered land adjoining riparian/wetland areas. Applying an NSO restriction on wetland areas greater than 40 acres would limit erosion and other detrimental impacts associated with oil and gas activity. In addition, Alternative B allows sediment reduction structures on a case-by-case basis, which would further protect riparian/wetland health. Watershed improvement projects under Alternative B are anticipated to disturb the highest number of acres. While these treatments may result in short-term impacts from surface disturbance, they would have greater long-term benefits on riparian/wetland areas than Alternative A.

Alternative C

Surface Disturbance

Unlike alternatives A and B, Alternative C allows surface-disturbing activities in floodplains or riparian/wetland areas and this alternative may therefore result in direct adverse impacts. By allowing surface-disturbing activities on a case-by-case basis, Alternative C is more likely to risk the impairment of riparian/wetland health through the introduction of invasive species and the removal of vegetation. Based on the percent cover of this vegetation type and the total projected surface disturbance (Table 4-1), there may be 1,539 acres of the short-term and 313 acres of the long-term surface disturbance in riparian/wetland areas on BLM-administered surface under this alternative. In addition, Alternative C has the largest projected total acreage of surface disturbance (Table 4-1) and would result in the greatest indirect adverse impacts to riparian/wetland resources from increased erosion and sediment loading. Alternative C is projected to result in the most short-term and long-term erosion (approximately 80 percent and 164 percent more, respectively, than Alternative A) which would result in the greatest adverse impact to riparian/wetland resources, compared to the other alternatives. As a summary, Table 4-8 lists the acreages of riparian/wetland areas protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative.

Resource Uses

The projected amount of surface disturbance associated with mineral development under Alternative C is the highest of the alternatives. Most of the Planning Area remains open to mineral extraction and the RFD of minerals facilities is the greatest under Alternative C, compared to the other alternatives. Most of the impacts would be temporary during the life of the operation, with most areas of disturbance reclaimed following closure of operations; however, in the short term, surface disturbance associated with minerals development may impair riparian/wetland areas. Under Alternative C, the BLM allows the proper disposal of water produced through mineral production activities. When surface discharge occurs in waterways on BLM-administered land, Alternative C requires the discharge of produced water be done in such a manner as to cause minimal environmental harm, while still contributing to designated uses. Impacts to riparian/wetland resources from the discharge of produced water would be similar to those under Alternative A, but to a greater degree due to more projected oil and gas activity.

Fewer restrictions on surface-disturbing activities in proximity to riparian/wetland areas under Alternative C would result in greater adverse impacts associated with invasive species than the other alternatives. An increase in invasive species would alter the vegetative communities, introducing species that use more water and lack the same high level of soil-binding properties as native riparian/wetland species. Invasive species and pest management under Alternative C prohibits aerial application of pesticides within 100 feet of riparian/wetlands but allows exceptions to manage riparian weed species. This management practice would result in impacts similar to those described under Alternative B. Alternative C does not require livestock flushing, which increases the chance of spreading ingested invasive species in riparian/wetland areas used by livestock.

Alternative C would result in the most short- and long-term surface disturbance from road and trail creation associated with recreational use and ROW development in the Planning Area. More roads in the Planning Area would increase associated erosion and surface runoff, which, in turn, would route water and sediment into nearby streams. As a result, road development under Alternative C would result in the greatest adverse impacts to riparian/wetland resources in the Planning Area.

Motorized vehicle use under Alternative C would result in impacts similar to those under Alternative A, but to a greater degree. Alternative C limits motorized vehicle use to existing roads and trails in most of

the Planning Area and closes the least area to motorized vehicle use compared to the other alternatives, resulting in more adverse impacts to wetlands and riparian resources. Alternative C also allows the use of off-road motorized vehicles to retrieve big game and access dispersed campsites, which may cause vegetation damage and erosion in some riparian/wetland areas. If demand warrants, the BLM would develop or upgrade recreation sites and associated amenities, resulting in impacts similar to Alternative A.

Most of the Planning Area would remain open to livestock grazing under Alternative C. The BLM manages livestock grazing to optimize commodity production while meeting rangeland health standards but not specifically to enhance other resource values; therefore, Alternative C would have the fewest beneficial impacts to riparian/wetland resources. In contrast to the other alternatives, Alternative C does not prohibit the placement of salt, mineral, or forage supplements near riparian/wetland areas, resulting in the greatest potential adverse impact to riparian/wetland areas. Concentrated livestock grazing or substantial increases in wild horse use may increase runoff in a watershed due to soil compaction and loss of vegetative cover. In addition, uncontrolled livestock grazing in these areas has a greater potential to introduce invasive species. Alternative C would result in the most livestock improvement projects. In the short term, these projects would result in increased surface disturbance; in the long term, however, these projects would result in the most beneficial impacts to riparian/wetland resources compared to the other alternatives.

Special Designations

Alternative C places the least restriction on surface-disturbing activities in special designations and designates the fewest number of these areas. As shown in Table 4-8 and Section 4.1.4 *Water*, Alternative C protects the fewest acres of wetlands and miles of streams within special designations. As a result of the limited additional protections provided by special designations, Alternative C would result in the fewest beneficial impacts to riparian/wetland areas.

Resources

Alternative C utilizes wildland fires and other vegetation treatment to restore fire-adapted ecosystems and enhance forage for commodity production and to reduce hazardous fuels. This management could result in an increase in wildland fires in the Planning Area, which would result in vegetative cover loss and sediment loading in streams.

Alternative C applies fewer management restrictions on surface-disturbing and disruptive activity designed to protect wildlife and special status species. Riparian/wetland areas in the Absaroka Front Management Area (444 acres) would receive fewer beneficial impacts than under Alternative B since some resource uses (e.g., oil and gas and other mineral leasing) that would be restricted under Alternative B would be allowed under this alternative. Management actions designed to improve fisheries are similar to Alternative A and would therefore result in similar beneficial impacts. Native ungulate grazing is anticipated to cause impacts to riparian/wetland areas similar to Alternative A.

Proactive Management

Alternative C manages riparian/wetland areas to meet PFC, giving priority to those areas functioning at-risk with a downward trend or in nonfunctioning condition. Prioritizing areas that do not meet the standard allows the BLM to efficiently allocate management resources to those areas most in need. Alternative C allows surface-disturbing activities in flood plains and riparian/wetland areas on a case-by-case basis. By not prohibiting surface-disturbing activities, Alternative C results in the fewest beneficial impacts compared to the other alternatives. Watershed improvement projects under Alternative C are anticipated to disturb the fewest number of acres. While fewer treatments would result in less short-

term impacts in terms of surface disturbance, they would provide fewer long-term benefits to these areas.

Alternative D

Surface Disturbance

Under Alternative D, impacts to riparian/wetland areas from surface disturbance would be similar to those under Alternative A, but to a greater degree. Based on the percent cover of this vegetation type and the total projected surface disturbance (Table 4-1), there may be 920 acres of short-term and 139 acres of long-term surface disturbance in riparian/wetland areas on BLM-administered surface under Alternative D. However, avoiding surface-disturbing activities within 500 feet, up to ¼ mile if needed to protect sensitive resources, of surface water and riparian/wetland areas would reduce the direct adverse impacts from surface disturbance in these areas similar to Alternative A. Alternative D is projected to result in 3 percent more short- and 17 percent more long-term erosion than Alternative A, with proportional indirect impacts to riparian/wetland resources—though the more stringent reclamation practices under Alternative D, relative to Alternative A, may limit erosion impacts to riparian/wetland areas to a greater degree. As a summary, Table 4-8 lists the acreages of riparian/wetland areas protected from some common surface-disturbing activities (e.g., ROWs and locatable mineral development) under this alternative. Although Alternative D is projected to result in more surface disturbance than Alternative A, with proportional indirect impacts to riparian/wetland areas, Alternative D includes more measures, described below, to limit direct adverse impacts to riparian/wetland areas from surface-disturbing activities.

Resource Uses

The BLM projects that Alternative D would result in a similar amount of surface disturbance from mineral development as Alternative A, resulting in a similar degree of adverse impacts. Most of the impacts would be temporary during the life of the operation, with most areas of disturbance reclaimed following closure of operations; however, in the short term, surface disturbance associated with minerals development may impair riparian/wetland areas. Impacts from produced water would be similar to those under Alternative C, although to a lesser degree because the BLM projects fewer new oil and gas wells under this alternative.

Adverse impacts from invasive species spread in riparian/wetland areas would be similar to those under Alternative A, but to a lesser degree. Management practices regarding pesticide application and livestock flushing would be similar to those under Alternative A, but applying an NSO on wetlands greater than 20 acres under Alternative D would limit the potential for invasive species spread to a greater extent.

Road development under Alternative D would result in impacts similar to Alternative A.

Under Alternative D, motorized vehicle use would result in impacts similar to Alternative A, but to a lesser degree. Alternative D limits motorized vehicle use to designated roads and trails in more areas and closes more areas to motorized vehicle use compared to Alternative A. Localized impacts from opening areas to motorized vehicle use would result in surface disturbance and potential indirect adverse impacts to riparian/wetland areas. Restricting off-road motorized vehicle use to within 300 feet of established roads would limit the extent of the adverse impacts described under Alternative A. Developing recreation sites would result in similar potential adverse impacts to those under Alternative A; however, Alternative D recognizes more SRMAs that contain riparian/wetland habitat, such as the

Bighorn River, The Rivers, Canyon Creek, Middle Fork of the Powder River, and Beck Lake SRMAs, which would limit surface disturbance and the associated impacts in these areas.

Livestock grazing management would result in impacts to riparian/wetland areas similar to Alternative A.

Special Designations

Special designations under Alternative D would result in similar beneficial impacts to riparian/wetland areas as under Alternative A, but to a greater degree. Alternative D proposes more special designations containing riparian habitat (see Table 4-8 and Section 4.1.4 *Water*) and places more restrictions on surface-disturbing activities in these special designations than alternatives A and C, but less than Alternative B.

Resources

Watershed improvement practices under Alternative D would result in similar beneficial impacts to riparian/wetland resources as under Alternative B.

Fire and fuels management under Alternative D would result in impacts similar to Alternative A.

Management actions to protect wildlife and special status species under Alternative D would result in similar beneficial impacts to those under Alternative A, but to a greater degree. Restrictions on mineral development in the Absaroka Front Management Area, which contains 887 acres of riparian/wetland area, would result in more beneficial impacts than under Alternative C, but less than Alternative B. Restoring streams and fisheries habitat would result in similar beneficial impacts as those under Alternative A.

Proactive Management

Proactive management under Alternative D would result in similar beneficial impacts to those under Alternative C, but to a greater degree. The BLM manages certain riparian/wetland areas containing streams with unique recreational or fishery values to obtain DFC. Management toward DFC is assumed to exceed the requirements of managing toward PFC and would therefore result in improved functioning and healthier riparian/wetland areas, although not to the degree afforded by management toward DPC (as under Alternative B). Watershed improvement projects would result in impacts similar to Alternative A.

4.4.4 Invasive Species and Pest Management

The presence of invasive species in the Planning Area is considered an adverse impact. Actions that contribute to the introduction of invasive species, the spread of existing invasive species populations, or that avoid, reduce, or prohibit invasive species control activities in the Planning Area also would be adverse impacts. Beneficial impacts include management actions that reduce or contain the spread of, or eradicate, invasive species in the Planning Area.

Direct impacts to the management of invasive species typically result from actions that disturb soil or that otherwise create environments (i.e., seedbed) for the establishment of invasive plant species (Map 30). Indirect impacts result from activities that avoid, reduce, or prohibit invasive species control activities in the Planning Area. The transport of invasive species seed or other plant parts by wildlife, livestock, vehicles, wind, or water to other locations, thereby expanding the distribution or increasing the range of spread of weeds, is also considered an indirect impact.

4.4.4.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Roadways, trails, ROWs, and corridors are major routes that can spread invasive species through transport on motor vehicles and off-road motorized vehicle uses. Invasive species also can spread through watercourses, wind, and by wildlife and livestock movement.
- The amount of new surface disturbance associated with an alternative is a good index of potential impact by invasive species. The larger the acreage of surface disturbance, the greater the potential adverse impact by invasive species.
- Success of reclamation measures prescribed as a condition of development is unknown and could either overestimate or underestimate the potential impact from weeds.
- Enforcement of restrictions related to recreation and off-road motorized vehicle use and dispersed travel can be assumed only if adequate funding and personnel are available to do the job.
- Instruction Memorandum (IM) 2006-073 (BLM 2006b) establishes policy and guidance for use of certified weed-free seed and mulch to prevent the establishment of new invasive species population in restoration projects on public lands.
- *Partners Against Weeds – An Action Plan for the BLM* (BLM 1996), establishes a strategy to prevent weeds through cooperation with all partners. It outlines goals and specific actions to help prevent and control the spread of weeds. This action plan, along with any future updates and guidance, would be followed to control and prevent weed problems.
- Seeds from some weeds can remain dormant and viable in the soil for periods that exceed the 5-year division between short- and long-term impacts. Therefore, favorable site conditions may serve to reintroduce invasive species to reclaimed sites without additional surface disturbance.
- The area evaluated for potential impacts includes the Planning Area and Big Horn, Hot Springs, Park, and Washakie County weed-control districts.
- The acreage of long-term disturbance (Appendix T) includes facilities that cannot be reclaimed and that, in most cases, would not provide long-term habitats for invasive species. For example, well pads, communication sites, powerlines, roads, wind-energy facilities, and other infrastructure would replace existing native vegetation with pervious or impervious surfaces for a period exceeding 5 years.
- Integrated Pest Management includes chemical, mechanical, biological, and cultural techniques.
- The introduction of aquatic invasive invertebrates, vertebrates, microorganisms, and pathogens can threaten the stability of ecosystems, create serious human health consequences, and cause substantial economic burdens. Large majorities of native and nonnative species do not pose a threat to natural or human systems. However, if any of these species were to become a concern, the WFO and CYFO would cooperate and coordinate with appropriate government agencies, private industry, and other interested parties involved in public education efforts and control, management, and research of invasive species.

4.4.4.2 Summary of Impacts by Alternative

Invasive species are expected to spread under all alternatives. Surface disturbance can increase invasive species by either damaging native vegetation and creating a space for the establishment of invasive species, or introducing invasive species seed and plant matter from machinery and other equipment. Correspondingly, alternatives projected to involve the greatest amount of surface disturbance would

have the greatest potential to increase the spread of invasive species. Stringent reclamation requirements, especially reclamation plans before surface disturbance, would decrease long-term disturbance and the likelihood of invasive species establishment. Based on projected surface disturbance, Alternative C would result in the greatest potential spread of invasive species, followed by alternatives A, D, and B respectively. Alternative D is projected to result in greater surface disturbance than Alternative A, but contains more stringent reclamation requirements that would result in a reduced potential for the spread of invasive species.

Fire and fuels management, motorized vehicle use, and livestock grazing would have the greatest impact on the spread of invasive species. Though disturbance caused by fire can spread invasive species, when conditions are favorable and proactive management to reestablish native plants follows closely after, fire can be a tool to reestablish historic fire regimes that favor native plants over invasive species. Alternative C would result in the greatest short-term adverse impacts from disturbance due to fire and fuels management and the greatest potential long-term benefits from restoration of historic fire regimes, followed by alternatives A, D, and B respectively. Closing areas to motorized vehicle use can help prevent the unintentional spread of invasive species; Alternative B restricts travel across the largest portion of the Planning Area, and would provide the greatest potential reduction in the spread of invasive species from motorized vehicles, followed by alternatives D, A, and C respectively. The potential adverse impacts from livestock grazing related spread of invasive species would be greatest under Alternative C due to fewer management options to control their spread (e.g., the option to require livestock flushing); alternatives A, D, and B, respectively contain more management options to control livestock grazing related invasive species spread.

4.4.4.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

All alternatives could result in proliferation of noxious and invasive weeds into areas considered weed-free, and there may be an increase in noxious and invasive weeds where they already exist. In general, surface-disturbing activities (e.g., mineral development, road construction) would adversely impact invasive species and pest management under all alternatives. Reclamation of these areas reduces the chance of invasive species establishment. Vegetation treatments would beneficially impact the management of invasive species under all alternatives. Treatments may cause short-term impacts to vegetation by decreasing vegetation production and increasing establishment of early successional species. Long-term impacts could include increased production and diversity of vegetation communities, thereby controlling the spread of invasive species.

ROW authorizations would contribute to the spread of invasive species under all alternatives. The road network is a major conduit for the initial spread of invasive species, although the availability to access areas also results in the opportunity to find and treat new infestations. ROWs concentrated in a corridor tend to localize or confine disturbance to a smaller area and reduce disturbance in areas identified as sensitive, which would minimize potential impacts from invasive species spread.

Indirect, adverse, short- and long-term impacts from transportation of materials, people, and vehicles occur throughout the Planning Area at recreation sites, trailheads, trails, and transportation routes. Invasive species are established in some of these areas and their seeds are spread to other areas by vehicles, people, livestock, and wildlife. Due to the permanent nature of most recreation sites, trails, and transportation routes, most associated adverse impacts under all alternatives are anticipated to be long-term.

Fire and fuels management is likely to impact invasive species and pest management. By destroying or damaging invasive plants and seeds, beneficial impacts can be realized based on the timing and location of fire. Conversely, adverse impacts from suppression activities that disturb soil and from fires that remove native vegetation and expose soil result in conditions that provide a seedbed for weed establishment, such as cheatgrass. Most weeds can out-compete native species and typically respond rapidly after fire. The likelihood of weed expansion after a wildland fire increases in areas where weeds occur or are nearby. Firefighters and their equipment may also introduce or spread weeds. Impacts of fire management are not just limited to terrestrial invasive species; the use of water for fire suppression and rehabilitation activities can also contribute to the spread of aquatic invasive species, which are anticipated to become a greater management challenge in the Planning Area. Under all alternatives, fire-fighting equipment must be cleaned in areas with high-risk aquatic invasive species to prevent the spread of these species. The adverse impacts from fire management may be direct or indirect because the impact(s) may or may not occur immediately.

Because all alternatives would be managed according to the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N), the types of adverse impacts from livestock grazing and wild horse use to vegetation and soil are expected to be similar among alternatives. The number and distribution of native ungulates and current allowable management levels of wild horses also are anticipated to be similar among alternatives, because the number of AUMs does not change by alternative. The impacts of livestock, wild horse, and native ungulate grazing on the management of invasive species from all alternatives are anticipated to result in a mix of beneficial and adverse impacts.

Livestock and wild horse grazing, depending on its timing and intensity, can cause variable impacts to invasive species. Short- and long-term adverse impacts associated with livestock, wild horse, and native ungulate grazing are anticipated primarily where these species concentrate (e.g., water sources, trails, favored forage) and include transport of weed seeds and disturbance of soil, creating environments for the spread of invasive species. As the vegetation of riparian/wetland areas is fragile and these areas are vulnerable to wildlife, wild horse, and livestock concentrations, so too are they vulnerable to the spread of invasive species. High densities of native ungulates can reduce or eliminate shrub seed production and impair recruitment of young shrubs (Kay 1995). In addition, as vegetation stubble height is reduced, there can be a shift in cattle preference and damage to vegetation (Hall and Bryant 1995). These impacts would be expected to result in adverse impacts by increasing the establishment of invasive species.

Livestock grazing management in accordance with guidelines associated with the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N) may result in beneficial impacts by improving rangeland health and decreasing the potential for the spread and establishment of invasive species. Studies have shown that proper livestock grazing management can increase a plant community's resistance to cheatgrass invasion after a disturbance such as wildland fire and effectively control other invasive species (Hall and Bryant 1995, Stohlgren et al. 1999, Davies et al. 2009). In addition, livestock grazing in sagebrush communities can increase plant species richness and diversity (Manier and Hobbs 2007), decreasing vulnerability to invasive species spread. The impacts described by these studies are expected to remain site-specific in the Planning Area under all alternatives.

Proactive management actions common to all alternatives that may control the spread of invasive species include watershed stabilization, the use of certified noxious weed-free vegetation products, developing and maintaining an invasive species and pest management plan, and subjecting surface-disturbing activities to the *Wyoming BLM Mitigation Guidelines for Surface-Disturbing and Disruptive*

Activities (Appendix H) and the BLM Reclamation Policy (BLM 2009l). The BLM also continues to collaborate with cooperating agencies and interested stakeholders in educating public lands users about the control of invasive species, funding development and implementation of integrated pest management, and reducing and preventing the expansion of cheatgrass. Other management actions common to all alternatives can adversely impact the control of invasive species, such as restricting aerial pesticide application when its use conflicts with other resource management objectives.

Alternative A

Surface Disturbance

The surface disturbance projected for Alternative A would contribute to the spread of invasive species, in both the short and long term. Short-term impacts would occur during the 5 years following disturbance while the soil is bare of vegetation and reclamation activities strive to stabilize the soil and revegetate the area. Long-term impacts would last longer than 5 years due to reclamation efforts not completely effective in preventing weed establishment.

Surface-disturbing activities from all actions listed in Appendix T provide opportunities for the establishment and spread of invasive species. It is anticipated that BLM actions under Alternative A would impact 136,415 acres over the short term and 15,710 acres over the long term in the Planning Area (Table 4-1). The impacts from invasive species spread due to surface disturbance under Alternative A are anticipated to be proportional with the intensity of reasonable foreseeable actions shown in Appendix T.

Under Alternative A, the BLM determines the rate of erosion and the degree of soil stability during rangeland health evaluations. The BLM requires the reestablishment of vegetative cover in disturbed areas within 5 years of initial seeding and routine seeding on a priority basis in disturbed areas, but does not require reclamation plans. Based on reclamation measures, Alternative A would have the highest opportunity for the spread of invasive species in disturbed areas. Under Alternative A, activities to control invasive species would disturb the surface of approximately 2,000 acres (Appendix T) that would be reclaimed in the long term. Surface disturbance to control weeds is likely to occur in areas already infested, and therefore is not likely to contribute to the spread of invasive species.

Resource Uses

Under Alternative A, mineral development would result in 25,390 acres of short-term and 12,969 acres of long-term surface disturbance (Appendix T). Most of the Planning Area would remain open to mineral extraction. Most of the impacts would be temporary during the life of the operation with most areas of disturbance reclaimed following closure of operations. Typically, a large portion of a mineral material site is disturbed leaving the area prone to the spread of invasive species.

Forest and woodland treatments and forest products would result in 30,000 acres of short-term surface disturbance under Alternative A, but that same acreage would be reclaimed (Appendix T). Alternative A allows for clear-cutting, which may cause adverse impacts by generating changes to the microclimate and destabilizing soil, thus facilitating the spread of weeds where seed sources are present. Harvesting timber on commercial forestland in a manner to protect watershed and riparian/wetland habitat values would minimize potential impacts from invasive species, which are more likely to spread to degraded habitats. Alternative A allows salvage of dead stands on a case-by-case basis but does not use the full range of silviculture treatments to manage endemic insect and disease outbreaks.

Utility corridors and linear ROWs in the Planning Area, including pipelines and powerlines, would result in 3,287 acres of short-term disturbance; however, impacts associated with these activities would be

reclaimed and mitigated to the extent practicable through standard operating procedures, resulting in minimal long-term disturbance (Appendix T). Motorized vehicle use to maintain these corridors has the potential to cause adverse impacts by contributing to the spread of weeds. The road network is a major conduit for the initial spread of invasive species, although the availability to access areas also results in the opportunity to find and treat new infestations. Alternative A results in 1,966 acres of short-term and 983 acres of long-term surface disturbance from road construction. The risk of adverse impacts due to the spread of invasive species is expected to increase proportionally with the long-term surface disturbance from new road construction.

Under Alternative A, the creation of new roads and trails for recreational purposes would result in 1,233 acres of short-term and 835 acres of long-term surface disturbance. Adverse impacts would result from the spread of invasive species into potentially undisturbed areas in the Planning Area, and may be correlated with the amount of surface disturbance (Appendix T). Alternative A closes 59,192 acres to motorized vehicle use, resulting in beneficial impacts by slowing the potential spread of invasive species transported by motor vehicles. Restricting motorized vehicle use (e.g., limiting motorized vehicle use to designated roads and trails in areas with fragile soils) would reduce the threat of invasive species establishment and spread.

The degree of recreational site development under Alternative A may result in adverse and beneficial impacts. The BLM projects recreational site development to result in approximately 350 acres of long-term surface disturbance, which may leave these areas more vulnerable to invasive species spread. However, when recreational developments confine dispersed recreation to areas with higher use (e.g., vehicle barriers), beneficial impacts may result by reducing surface disturbance and the potential for introduction of invasive species to undisturbed areas. In addition, detection and treatment of new noxious weed infestations are more likely at centrally developed locations than over larger areas with more dispersed recreational activity. At developed sites, educational and prevention materials can be displayed and interpreted to the public resulting in the potential for lower risk of new infestations over time. However, when developments are likely to generate more visitors (e.g., trail or access route improvements) then they are likely to cause adverse impacts, as recreationists spread the seeds and material of weeds. In general, recreation management actions under Alternative A call for more development, if demand warrants, of facilities to augment and enhance visitor use and enjoyment including fire rings, sanitary facilities, parking areas, road improvements and vehicle barriers, the impacts of which are likely to be site specific.

Alternative A prohibits the placement of salt, mineral, or forage supplements within ¼ mile of water, wetlands, riparian, or other areas with sensitive vegetation, such as reclaimed or reforested areas. This restriction would provide beneficial impacts by preventing livestock and native ungulate concentration, therefore reducing the potential to spread invasive species in these areas.

Under Alternative A, the BLM evaluates "I" category livestock grazing allotments and AMPs to determine if they are meeting the *Wyoming Standards for Healthy Rangelands*, resulting in the least amount of monitoring among the alternatives. Based on the lack of a required 72-hour holding period for livestock (see 'Proactive Management' below) and less monitoring of grazing allotments, livestock grazing under Alternative A is anticipated to have short- and long-term adverse impacts.

Special Designations

In general, special designations under Alternative A (ACECs and WSAs) place restrictions on surface-disturbing activities (e.g., mineral development, ROW development, and fire suppression) that may facilitate the spread of weeds. These restrictions would result in beneficial impacts to the management of invasive species. Current management designates nine ACECs under Alternative A.

Resources

Resource management actions would result in adverse and beneficial impacts to invasive species and pest management. Managing to maintain or enhance native vegetation would result in indirect beneficial impacts by controlling the spread of weeds. Other resource programs may also result in adverse impacts to managing invasive species, primarily by limiting their control (e.g., restricting the application of pesticides) to avoid conflicts with other resource management objectives.

Management actions specific to Alternative A allow the aerial application of pesticides on a case-by-case basis, the most efficient means of controlling invasive species at the landscape scale, thereby beneficially affecting invasive species and pest management.

Alternative A utilizes fire to restore fire adapted ecosystems and reduce hazardous fuels. Vegetation response following planned ignitions and mechanical and chemical treatment varies depending on a set of factors such as fire conditions, timing, and pre- and post-treatment weather conditions. Impacts to the spread of invasive species from fire and fuels management under Alternative A are likely to be site and species specific. No specific management actions that address the use of fire to control weed species exist under Alternative A. Based on projected surface disturbance (Appendix T), fire and fuels management under Alternative A may result in adverse impacts in areas where fire facilitates the spread of invasive species, such as cheatgrass, and beneficial impacts where it restores native fire-adapted vegetation.

Under Alternative A, vegetation management involves implementing DPC objectives for watershed protection, forestland management, and livestock grazing on 600,000 acres. Widespread vegetation management may result in beneficial impacts by controlling and monitoring the spread of invasive species in these managed areas. Vegetation not meeting DPC has the highest risk of having lost or losing key ecosystem components that make these areas more vulnerable to invasive species establishment. Managing riparian/wetland areas toward achieving PFC would result in beneficial impacts by controlling the spread of invasive species in these areas.

Proactive Management

Proactive management actions specific to the invasive species and pest management program would focus on aerial pesticide restrictions and livestock flushing. Allowing the aerial application of pesticides on a case-by-case basis would result in the greatest beneficial impact to the management of invasive species by placing the fewest restrictions on aerial pesticide application.

The transport of invasive species seeds and material by livestock and native ungulates occurs when they attach to the animals' coats and feet or are ingested. One method to control the spread of invasive species ingested by livestock is to hold the animals in one area before they are allowed to move to other areas. A holding period of 72 hours allows the animals to flush the ingested weed material from their systems so they would not transport the ingested material to uninfested areas. Alternative A requires livestock flushing on a case-by-case basis, but does not require a holding period before moving livestock onto or within public lands. Proactive management actions under Alternative A are expected to help control the spread of invasive species.

Alternative B

Surface Disturbance

The projected long-term disturbance acreage for Alternative B is approximately 30 percent less than Alternative A, 74 percent less than Alternative C, and 41 percent less than Alternative D. Compared to

the other alternatives, Alternative B has the strictest requirements (e.g., 50 percent pre-disturbance of vegetative cover within three growing seasons, 80 percent cover within 5 years of initial seeding, topsoil salvage, and development of a reclamation plan before surface disturbance) regarding the reclamation of disturbed areas. These measures would result in beneficial impacts decreasing the likelihood of invasive species establishment and spread. Although the extent of treatments for invasive species and pests would be less under this alternative—indicated by the projected surface disturbance from invasive species and pest management (Appendix T)—the less overall surface disturbance and proactive reclamation requirements under Alternative B may result in the least adverse impact due to the least potential for the spread of invasive species.

Resource Uses

Under Alternative B, mineral development would result in 17,327 acres of short-term surface disturbance and 6,217 acres of long-term surface disturbance, likely having the least adverse impact to invasive species management, compared to the other alternatives (Appendix T). The types of impacts from mineral development under Alternative B would be similar to those under Alternative A.

Forest and woodland treatments and recovery of forest products are projected to result in 20,000 acres of short-term surface disturbance under Alternative B (Appendix T); however, all of this acreage would be reclaimed. Alternative B prohibits clear-cutting, which is likely to result in beneficial impacts by maintaining microclimatic and soil conditions so there is less opportunity for the establishment of invasive species. Timber harvest is only allowed in areas where natural processes are unable to accomplish forest health goals, likely resulting in less use of motorized machinery that can disturb soils and carry invasive species seeds. Under Alternative B, these practices would have the most beneficial impact by slowing the spread of invasive plant species, compared to the other alternatives. However, managing endemic insect and disease outbreaks only as necessary for human health and safety and prohibiting precommercial thinning would adversely affect pest management by limiting bark beetle control efforts.

Utility corridors and linear ROWs in the Planning Area, including pipelines and powerlines, would involve 2,425 acres of short-term and 1 acre of long-term surface disturbance (Appendix T), which would result in impacts similar to Alternative A, but to a lesser degree. Alternative B would involve 1,229 acres of short-term and 614 acres of long-term surface disturbance due to road construction, the least of all alternatives. The risk of adverse impacts from the spread of invasive species is expected to increase proportionally with long-term surface disturbance from new road construction.

Under Alternative B, the creation of new roads and trails for recreational purposes would result in 2,776 acres of short-term and 1,068 acres of long-term surface disturbance, the second least of the alternatives (Appendix T). The resulting impact would be the potential spread of invasive species into new areas where disturbance occurs. Alternative B closes the largest area to motorized vehicle use and limits motorized vehicle use to designated roads and trails in the largest area, compared to the other alternatives. Restricting motorized vehicle access would reduce the area to which vehicles may spread invasive species; however, restricting vehicle access would also make detection and subsequent treatment of new or expanding weed areas more difficult. Prohibiting off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations would result in beneficial impacts by controlling the spread of invasive species from motorized travel the most, compared to the other alternatives. For known weed infestations selected for treatment, the BLM may authorize motorized vehicle use for performing treatment activities, where appropriate. Adverse impacts from motorized vehicle use would be the least under Alternative B.

In areas developed for recreational use outside of SRMAs, further development to enhance recreation and visitor services would generally be the least extensive under Alternative B. However, recreational development in SRMAs and RMZs would be greatest under Alternative B. Developments would include new trails and trailheads, access route improvements, and new motorized touring loops that may increase public access and the potential for invasive species spread but may also consolidate recreational activity to facilitate potential detection and treatment. Due to more intensive management of SRMAs and RMZs to maintain the desired recreation setting and, therefore, the more active control of invasive species, recreational use under Alternative B would result in fewer adverse impacts to invasive species and pest management than under Alternative A.

Alternative B prohibits the placement of salt, mineral, or forage supplements within ½ mile of water, wetlands, riparian, or other areas with sensitive vegetation such as reclaimed or reforested areas. This alternative provides the largest buffer and would, therefore, provide the greatest beneficial impacts by controlling the spread of invasive species by livestock and native ungulates in these vulnerable areas.

Under Alternative B, the BLM closes large areas—including crucial winter range for elk and greater sage-grouse Key Habitat Areas—to livestock grazing, allowing existing uses pending site-specific analysis. Closing areas to livestock grazing would limit the transport of invasive species and reduce the overall consumption of native vegetation, improving plant vigor, and resulting in more effective native plant competition over possible invasive species introduction. However, prohibiting livestock grazing may preclude its use as a tool to control invasive species in certain areas (Stohlgren et al. 1999 and DiTomaso 200). The opportunity for risk of introduction of noxious weed seeds by wildlife or birds would still remain under this alternative.

The BLM monitors those allotments not meeting rangeland health standards due to livestock grazing under Alternative B. This management action may require an increase in rangeland monitoring, compared to other alternatives, which would provide beneficial impacts by monitoring the spread of invasive species to better serve control and treatment efforts.

Special Designations

In general, special designations (e.g., ACECs and WSAs) under Alternative B place the most restrictions on surface-disturbing activities (e.g., mineral development, ROW development, and fire suppression) that facilitate the spread of invasive species. In addition to the nine ACECs designated under Alternative A, four existing ACECs would be expanded, and eight new ACECs designated. Although seasonal stipulations on invasive, nonnative pest species control in the Chapman Bench, Clarks Fork Canyon, Rattlesnake Mountain, and Sheep Mountain ACECs may adversely impact invasive species management by restricting control methods or timing, ACEC designations under this alternative would place restrictions on actions most likely to contribute to the spread of invasive species, resulting in the greatest beneficial impacts to invasive species control, compared to the other alternatives. Two back country byways would be designated and developed under Alternative B. If these designations and facility developments increase use from motorized vehicles, then adverse impacts may result from increased potential to spread invasive species along these byways.

Resources

Alternative B would utilize fire to restore fire adapted ecosystems and reduce hazardous fuels. Vegetation response following planned ignitions and mechanical and chemical treatment typically varies depending on a set of factors such as fire conditions, timing, and pre- and post-treatment weather conditions. Alternative B uses mechanical, chemical, or biological treatments in the wildland urban interface to protect structures and private property from fire. Mechanical treatments may cause

adverse impacts by increasing the potential of invasive species spread, because the surface disturbance associated with these treatments would occur in habitat that may already be degraded. In other situations, such as in areas affected by cheatgrass, burning has a greater adverse effect on weed spread than some mechanical treatments may have (Keeley 2006). Although fire and fuels management under Alternative B may result in the least short-term surface disturbance overall (Appendix T) and therefore the least adverse impact by spreading invasive species, it would also result in the least long-term beneficial impact from restoring native fire-adapted vegetation.

Under Alternative B, vegetation management would be less extensive than alternatives A, C, or D. Though the BLM would manage toward achieving 75 percent of Historical Climax Plant Community and to maintain native plant communities on contiguous blocks of BLM-administered land—resulting in beneficial impacts by limiting new areas susceptible to invasive species spread due to improved habitat integrity—the greater reliance on natural processes for vegetation treatment under this alternative would result in the smallest beneficial impact. Alternative B also prohibits the aerial application of pesticides within 1 mile of special status plant species populations, which may result in adverse impacts by limiting widespread pesticide use to control invasive species spread. As managing riparian/wetland areas toward DPC is assumed to exceed the requirements of managing toward PFC, Alternative B may result in greater beneficial impacts than Alternative A by controlling the spread of invasive species in these areas.

Proactive Management

The BLM prohibits the aerial application of pesticides within ½ mile of riparian/wetland areas and aquatic habitats under Alternative B. Although this restriction may adversely affect the control of invasive species, exceptions can be made to manage riparian weed species when the beneficial impacts of invasive species control are greater than the risks to aquatic habitat from pesticides applied in conformance to label requirements.

Allowing the authorized officer, on a case-by-case basis, to hold livestock that may have ingested invasive species material or seeds for a period of 72 hours would reduce the potential of livestock to transport invasive species material or seeds under Alternative B. This allows the animals to flush the ingested invasive species material from their systems before moving on to or within public lands. It is anticipated that this action, more than actions under other alternatives, may reduce the adverse, indirect impacts associated with the spread of invasive species from livestock.

Alternative C

Surface Disturbance

Alternative C is projected to result in the greatest acreage of short-term surface disturbance. The projected long-term disturbance acreage for Alternative C is approximately 164 percent more than Alternative A, 282 percent more than Alternative B, and 125 percent more than Alternative D. Alternative C has less stringent reclamation requirements (e.g., 30 percent desired vegetative cover within three growing seasons, and no subsequent requirement) than alternatives B and D, but potentially more stringent requirements than Alternative A by requiring reclamation plans on a case-by-case basis. Additionally, seeding of areas not meeting resource objectives using approved seed mixes containing both native and nonnative species may allow for the selection of species most capable of competing with invasive species and, therefore, reduce the chances of invasive species establishment in these areas relative to Alternative A. Alternative C is likely to result in the most short- and long-term adverse impacts by providing the most opportunity for invasive species spread in disturbed areas. Although the extent of treatments for invasive species and pests would be twice that of alternatives A

and D and 40 times more than Alternative B—indicated by the projected surface disturbance from invasive species and pest management (Appendix T)—the greater overall surface disturbance and limited requirements for revegetation under Alternative C may have the greatest adverse impacts to invasive species and pest management.

Resource Uses

Under Alternative C, mineral development would result in 25,771 acres of short-term and 13,120 acres of long-term surface disturbance (Appendix T). Thus, Alternative C would result in similar adverse impacts to those under Alternative A, but to a greater degree. Most of the Planning Area would remain open to mineral extraction, with the least acreage closed compared to the other alternatives. Most of the impacts would be temporary during the life of the operation with most areas of disturbance reclaimed following closure of operations.

Forest and woodland treatments and recovery of forest products would result in 40,000 acres of short-term surface disturbance under Alternative C, but no long-term surface disturbance due to complete reclamation of these sites (Appendix T). Alternative C would allow larger clear-cuts than Alternative A and the continued use of spur roads to complete other resource goals or for new recreational purposes would increase the potential spread of invasive species from vehicle use in these areas. Commercial forestland would be open to timber harvesting, resulting in the greatest adverse impacts for potential invasive plant species spread from motorized machinery and soil disturbance, compared to the other alternatives. However, managing endemic insect and disease with the full range of silviculture techniques and treatment methods and allowing precommercial thinning and salvage operations would beneficially impact pest management such as bark beetle control.

Utility corridors and linear ROWs in the Planning Area, including pipelines and powerlines, would involve 3,460 acres of short-term and 1 acre of long-term surface disturbance (Appendix T), which would result in impacts similar to Alternative A, but to a greater degree. Alternative C would involve 4,638 acres of short-term and 2,319 acres of long-term surface disturbance from road construction, the most of all alternatives (Appendix T). The risk of adverse impacts due to the spread of invasive species is expected to increase proportionally with long-term surface disturbance from new road construction.

Under Alternative C, the creation of new roads and trails for recreational purposes would result in 12,907 acres of short-term and 12,735 acres of long-term surface disturbance, the most of all the alternatives (Appendix T). The resulting impact would be the potential spread of invasive species into new areas where disturbance occurs. Alternative C limits motorized vehicle use to designated roads and trails in less acreage than alternatives B and D—though more acreage than Alternative A—closes the least acreage to motorized vehicle use, and allows off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations, which would result in the greatest potential adverse impacts from the spread of invasive species, compared to the other alternatives. Conversely, less restrictive travel management under this alternative would allow the greatest access to detect new and treat existing invasive species infestations, which may result in a beneficial impact to the control of these species.

In areas developed for recreational use, impacts from recreational development under Alternative C would be similar to those under Alternative A, but to a greater degree. The potential visitor increase to recreational areas may be greater than Alternative B, but if the BLM upgrades or develops facilities in response to demand, the consolidation of recreational activity may result in beneficial impacts to invasive species and pest management as described under Alternative A. Alternative C manages the least areas as SRMAs, and therefore would pursue the least intensive management to maintain the desired recreation setting, resulting in the least beneficial impact to invasive species control.

Alternative C allows the placement of salt, mineral, or forage supplements in wetlands, riparian, or other areas with sensitive vegetation such as reclaimed or reforested areas to maximize livestock use. The potential concentrated livestock use and associated soil disturbance and invasive species spread would be the greatest under Alternative C, compared to the other alternatives.

Under Alternative C, the BLM excludes livestock grazing from the same areas as Alternative A but manages livestock grazing to optimize commodity production while meeting rangeland health standards, not to provide for the enhancement of other resource values. The potential adverse impacts by allowing livestock grazing in areas where it is likely to contribute to, rather than help control, the spread of invasive species would be greatest under this alternative. Alternative C, by prioritizing monitoring on "I" category allotments and those allotments not meeting rangeland health standards due to current livestock grazing, would result in more monitoring to aid invasive species detection and treatment than Alternative A.

Special Designations

In general, special designations (e.g., ACECs and WSAs) under Alternative C would place the least restrictions on surface-disturbing activities (e.g., mineral development, ROW development, and fire suppression) that facilitate the spread of invasive species. Furthermore, only the Spanish Point Karst and Brown/Howe Dinosaur Area ACECs would be designated under this alternative, providing the fewest beneficial impacts from special designations from limiting surface disturbance to control the spread of invasive species, compared to the other alternatives.

Resources

Alternative C would utilize fire to restore fire adapted ecosystems and reduce hazardous fuels. Vegetation response following planned ignitions and mechanical and chemical treatment varies depending on a set of factors such as fire conditions, timing, and pre- and post-treatment weather conditions. Mechanical, chemical, or biological treatments would be used across the landscape as needed to restore vegetative diversity and reduce the risk of unnatural fire. Although fire management actions result in the greatest amount of surface disturbance in the short term, by restoring vegetative diversity the risk of invasive species establishment would decrease, resulting in beneficial impacts in the long term. Under Alternative C, the BLM would seek to restore vegetation diversity while decreasing the risk of unnatural fire. Fire management under this alternative is likely to result in the greatest long-term beneficial impact, compared to the other alternatives.

Under Alternative C, the BLM manages grasslands and shrublands toward meeting the *Wyoming Standards for Healthy Rangelands* (Appendix N) in the greatest acreage, compared to the other alternatives. However, the BLM does not manage to maintain native species on contiguous blocks of BLM-administered land. Managing all riparian/wetland areas to meet or make progress toward PFC while prioritizing areas functioning at-risk with a downward trend or in nonfunctioning condition would focus management on those areas most vulnerable to invasive species spread and may result in a greater beneficial impact than riparian/wetland management under Alternative A. Due to the larger extent of vegetation management, Alternative C may result in more beneficial impacts to control the spread of invasive species than alternatives A, B, and D.

Prohibiting the aerial application of pesticides within ½ mile of special status plant species would result in a greater potential adverse impact than Alternative A, but less than Alternative B, by limiting widespread pesticide use to control invasive species.

Proactive Management

The BLM prohibits aerial application of pesticides within 100 feet of riparian/wetland areas and aquatic habitats under Alternative C. Although this restriction would adversely affect the control of invasive species, exceptions could be made to manage riparian weed species, when the beneficial impacts of invasive species control are greater than the risks from pesticides to aquatic habitat when applied in conformance with the label. Proactive management under Alternative C includes expansion of integrated pest management for identified infestations, a beneficial impact, but a reduction in livestock management measures (i.e., livestock flushing) that may prevent new infestations, an adverse impact.

Alternative D

Surface Disturbance

The projected long-term disturbance acreage for Alternative D is approximately 17 percent more than Alternative A, 69 percent more than Alternative B, and 57 percent less than Alternative C. Overall, Alternative D has more stringent reclamation requirements than alternatives A and C, but less than Alternative B. The BLM allows nonnative species for seeding, which would result in similar beneficial impacts to those under Alternative C. Alternative D is likely to result in more short-term adverse impacts than Alternative A, but less long-term adverse impacts by employing reclamation practices that reduce the opportunity for invasive species spread in disturbed areas. The extent of treatments for invasive species and pests under Alternative D is similar to that under Alternative A.

Resource Uses

Under Alternative D, mineral development would result in 24,896 acres of short-term and 12,596 acres of long-term surface disturbance (Appendix T). Mineral development under Alternative D would result in similar adverse impacts to those under Alternative A, but to a lesser degree.

Forest and woodland treatments and recovery of forest products would result in impacts similar to Alternative A, but to a greater degree from allowing clear cuts up to 100 acres. However, managing endemic insects and disease with the full range of silviculture techniques and treatment methods and allowing precommercial thinning and salvage operations would create beneficial impacts similar to Alternative C.

Under Alternative D, utility corridors, new road construction, and linear ROWs, including pipelines and powerlines, would result in impacts similar to Alternative A. However, managing more area as ROW avoidance/mitigation or exclusion areas under this alternative may consolidate ROW development and, therefore, limit the dispersal of invasive species.

Under Alternative D, the creation of new roads and trails for recreational purposes would involve 5,820 acres of short-term and 1,879 acres of long-term surface disturbance, the second most of the alternatives (Appendix T). The resulting impact would be the potential spread of invasive species into new disturbed areas. Alternative D closes the second largest acreage to motorized vehicle use and limits motorized vehicle use to designated roads and trails in the second largest acreage compared to other alternatives. Alternative D also limits off-road vehicle travel for big game retrieval and dispersed campsite access to within 300 feet of established roads. Under Alternative D, beneficial and adverse impacts to invasive species management would be greater than under alternatives A and C, but less than under Alternative B.

Recreational development under Alternative D in areas outside SRMAs would result in impacts similar to Alternative C. Recreation management actions in SRMAs would result in impacts similar to those under Alternative B, but to a lesser extent because SRMAs encompass less acreage under Alternative D.

Livestock grazing management under Alternative D would result in impacts similar to Alternative A. Allotment monitoring would cause beneficial impacts similar to Alternative C, but to a greater degree. Prioritizing monitoring on allotments that do not meet rangeland health standards due to all livestock grazing, not just current, may increase monitoring in more areas vulnerable to invasive species spread.

Special Designations

Special designations under Alternative D would result in impacts similar to Alternative A, but to a greater degree. In addition to the nine ACECs designated under Alternative A, Alternative D designates four new ACECs and two new management areas that emphasize resource protection, placing more restrictions on resource uses and activities likely to contribute to the spread of invasive species. Although seasonal stipulations on controlling invasive, nonnative pest species in the Chapman Bench Management Area and the Clarks Fork Canyon and Sheep Mountain ACECs may adversely affect invasive species management by restricting control methods or timing, ACEC designations under Alternative D would create more beneficial impacts than under alternatives A and C by limiting the spread of invasive species.

Resources

Fire and fuels management practices under Alternative D would result in impacts to invasive species and pest management similar to Alternative A in both extent and intensity. Similar to Alternative B, Alternative D places more emphasis on using fire as a resource management tool, which may beneficially impact invasive species management if the BLM uses fire more frequently in areas where it helps to control the spread of invasive species.

Vegetation management under Alternative D would create beneficial impacts similar to Alternative B, but to a lesser degree and extent. Based on the amount of projected surface disturbance (Appendix T), Alternative D would actively manage a similar amount of vegetation as Alternative A. However, managing grasslands and shrublands toward achieving 65 percent or more of Historical Climax Plant Community and maintaining contiguous blocks of native plant communities would create more beneficial impacts, similar to Alternative B but to a greater extent. Management of riparian/wetland vegetation would create beneficial impacts similar to Alternative C, but to a greater degree because Alternative D manages certain areas to obtain DFC, which requires more intensive management than PFC.

Avoiding aerial applications of herbicides within ½ mile of BLM special status plant species would result in similar adverse impacts to invasive species management as those under Alternative C, but to a lesser degree.

Proactive Management

Proactive management actions to control the spread of invasive species under Alternative D would create impacts similar to Alternative A.

Fish and Wildlife Resources

Certain types of management that restricts surface-disturbing activities and other resource uses would, generally, provide habitat protection for fish, wildlife, special status species, and wild horses. Table 4-9 below provides an overview of these selected protective management actions by important habitat types where they would occur for each alternative. This table is intended to provide a comparative overview comparison of the alternatives. Further discussion of the effects of these and other management actions for each fish and wildlife habitat types is provided in the proceeding sections. Impacts to special status species appear in sections 4.4.7 through 4.4.9, and impacts to wild horses appear in Section 4.4.10.

Table 4-9. Summary of Protective Management by Alternative for Selected Fish, Wildlife, Special Status Species, and Wild Horse Habitat

	Alternative	Big Game Crucial Winter Range (acres)	Big Game Parturition Habitat (acres)	Fish-bearing Streams (miles)	Greater Sage-grouse Key Habitat Areas (acres)	Herd Management Areas (acres)
Locatable Minerals - Closed	A	24,755	5,828	64	9,552	0
	B	120,623	45,921	80	80,687	0
	C	10,402	920	11	4,173	0
	D	16,921	2,935	32	8,714	0
Oil and Gas Constraints - Closed	A	45,855	2,495	35	37,933	27,763
	B	817,576	73,646	122	1,226,064	248,560
	C	41,165	551	16	35,435	27,763
	D	109,768	72,019	47	74,481	27,640
Oil and Gas Constraints - Major	A	679,240	71,264	122	534,236	22,698
	B	487,758	6,815	52	0	40,647
	C	82,360	4,617	103	46,564	10,772
	D	46,387	5,435	26	21,789	4,367
Oil and Gas Constraints - Moderate	A	580,238	6,702	16	512,190	103,074
	B	0	0	2	0	3
	C	683,976	60,671	44	809,855	87,092
	D	1,622,938	89,373	93	1,423,567	148,356
ROW - Exclusion	A	36,161	712	60	20,729	7,240
	B	109,839	18,359	60	132,248	7,168
	C	1,007	0	2	0	0
	D	9,961	0	5	264	0
Lands with Wilderness Characteristics[1]	A	N/A	N/A	N/A	N/A	N/A
	B	246,064	37,900	59	200,959	78,032
	C	N/A	N/A	N/A	N/A	N/A
	D	39,311	22,772	13	4,414	0
Livestock Grazing - Closed	A	1,479	41	3	312	22
	B	1,298,07	65,608	140	1,231,095	155,690
	C	1,479	41	3	312	22
	D	1,479	41	3	312	22
ACEC	A	32,433	12,612	29	20,461	0
	B	144,012	64,929	43	94,399	0
	C	11,241	392	8	5,268	0
	D	51,138	26,242	31	23,144	0

Table 4-9. Summary of Protective Management by Alternative for Selected Fish, Wildlife, Special Status Species, and Wild Horse Habitat (Continued)

	Alternative	Big Game Crucial Winter Range (acres)	Big Game Parturition Habitat (acres)	Fish-bearing Streams (miles)	Greater Sage-grouse Key Habitat Areas (acres)	Herd Management Areas (acres)
WSR	A	20,745	3,807	51	7,446	0
	B	20,745	3,807	51	7,446	0
	C	N/A	N/A	N/A	N/A	N/A
	D	N/A	N/A	N/A	N/A	N/A
WSA	A	38,378	338	16	35,673	28,392
	B	38,378	338	16	35,673	38,268
	C	38,378	338	16	35,673	28,392
	D	38,378	338	16	35,673	38,268

Source: BLM 2009a
[1]Includes only lands designated as Wild Lands.

ACEC Area of Critical Environmental Concern
N/A not applicable
ROW rights-of-way
WSA Wilderness Study Area
WSR Wild and Scenic River

4.4.5 Fish and Wildlife Resources – Fish

Wyoming state and federal resource management agencies manage aquatic species (including fish) in the Planning Area. The WGFD has statutory responsibility to protect all aquatic wildlife and is responsible for regulating the sport and commercial take of all fish in the Planning Area. The BLM manages the habitat on BLM-administered lands that supports both game and nongame fish species where they are found, and BLM management indirectly affects all aquatic species both upstream and downstream of BLM-administered lands. This analysis describes the potential impacts to fish habitat on BLM-administered lands.

Adverse impacts result from management actions that degrade fish habitat, including impacts to riparian/wetland habitat, changes in water quality (e.g., temperature, chemistry, etc.), or decreases in water quantity (e.g., natural flow regime) in the Planning Area. Beneficial impacts are those that improve or preserve riparian/wetland habitats and water quality or quantity by maintaining natural flow regimes.

Both natural events and human activities that result in changes to or stressors on habitat components such as vegetation, water quality, or water quantity may result in direct and indirect impacts to fish resources. Direct impacts include management actions that cause onsite disturbances to fish habitat. In addition, management actions that impact recreational access by the public to fish resources would be a direct impact to this resource. Indirect impacts include management actions that result in changes in water quality and quantity that subsequently affect fish. Actions that increase the transport of sediment to and through streams or increase deposition in streams are also considered indirect impacts.

4.4.5.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Activities that cause substantial disturbance to soils and vegetation may adversely affect water quality and quantity, which adversely affects fisheries habitats.

- Surface disturbances accelerate runoff and sediment delivery to stream channels, which alters streamflows and reduces habitat quality for fish that require clear water, moderated streamflows, and clean substrates.
- Increased sedimentation adversely affects most fish species in the Planning Area. This analysis, therefore, focuses on the degree of surface disturbance anticipated under each alternative.
- The potential for sedimentation of streams and rivers is minimized through using BMPs.
- The health of fisheries in the Planning Area is directly related to the overall health and functional capabilities of riparian/wetland resources, which in turn reflect watershed health.
- As riparian systems adjust in response to the removal of vegetation or changes in hydrologic conditions, the availability of habitats required to fulfill the life history requirements of fish populations is likely to be affected.

4.4.5.2 Summary of Impacts by Alternative

The principle impacts to fish result from management that increases surface disturbance, resulting in sedimentation and other adverse impacts to water quality and quantity in fishbearing streams. Increased sediment in fish habitat (streams, rivers, and reservoirs) decreases the potential for fish to naturally reproduce, fills in pools, leads to channel degradation, decreases light penetration and productivity, alters fish community composition, and increases stream temperature. Alternative C places the fewest restrictions on surface-disturbing activities and has the greatest potential to adversely affect fish habitat, followed by alternatives A, D, and B respectively. Alternative D is projected to result in greater surface disturbance than Alternative A, but contains more stringent reclamation requirements that may limit erosion to a greater degree and, therefore, mitigate adverse impacts to fish habitat. Alternative B would result in the greatest direct beneficial impacts to fisheries through proactive management (e.g., watershed improvement projects), followed by alternatives D, A, and C respectively.

4.4.5.3 Detailed Analysis of Alternatives

Potential impacts to fish habitat generally occur in relation to water quality and water quantity as these characteristics directly affect the ability of fish habitat to sustain fish. The analysis below is structured by these headings to identify management that would result in impacts to these characteristics of aquatic habitats. Section 4.1.4 *Water* includes additional detail on potential impacts to water quality and quantity from implementing alternatives. Section 4.4.3 *Vegetation - Riparian/Wetland Resources* describes impacts to riparian/wetland habitat that may also affect fish habitat.

Impacts Common to All Alternatives

The principle impacts to fish habitat result from management actions that affect water quality and quantity. These impacts would be similar under all alternatives, but the degree and intensity of impacts vary by alternative based on restrictions, allocations, projected activity, and other management, as described for each alternative. See Impacts Common to All Alternatives in Section 4.1.4 *Water* for a detailed analysis of impacts to surface water quality and quantity. See Section 4.1.3 *Soils* and Appendix V for a more detailed description of the methods used to predict the erosion rates that appear below.

Water Quality

Under all alternatives, fish habitat would be affected by management actions that alter water quality through sedimentation and related degradation from surface-disturbing activities, water temperature changes, water chemistry changes, and riparian area management and restoration.

Increased sediment in fish habitat (streams, rivers, and reservoirs) decreases the potential for fish to naturally reproduce, fills in pools, leads to channel degradation, decreases light penetration and productivity, alters fish community composition, and increases stream temperature. Activities that increase surface runoff can erode stream banks, altering riparian habitat and reducing the quality of in stream habitat for fish. Changes in aquatic habitats could lead fish to alter their uses of the stream, moving to different areas for feeding and spawning, or eliminate their ability to survive, depending on habitat conditions.

As noted in Section 4.1.4 *Water*, concentrated grazing by livestock, wild horses, and wildlife may contribute to soil compaction and damage to the vegetative cover and soil crust, thus increasing surface water runoff, erosion, and sedimentation. Fishbearing streams do not flow through the McCullough Peaks or Fifteenmile HMAs under any alternative, so adverse impacts from wild horses would be minimal under all alternatives.

Water Quantity

Water quantity is primarily affected by activities that alter water runoff and water discharge. In areas with little vegetation, less rainfall infiltrates the soil and therefore more runoff may reach stream systems. Greater runoff can cause accelerated erosion and increased sediment loading in streams and rivers. Impervious surfaces and compacted soils may result in higher volumes of water reaching stream systems in shorter time periods, thus increasing flow rate, flood frequency, and erosion. Stream bank disturbance could impact fish habitat by creating bank instability, which could alter flow and destroy pool-riffle formations needed for fish survival.

Produced water from conventional and CBNG wells is sometimes discharged to the surface, contributing additional flows into the surface water system. These discharges can alter the timing, location, and volume of local streamflow patterns. In the Planning Area, produced water discharges, although overall beneficial to stream habitat, result in both beneficial and adverse impacts. Particularly during periods of low flow and spawning, aquatic species may be affected by the amount of produced water discharged to the surface. Produced water discharge can increase flow rates and erosion in stream channels, contributing to sedimentation. BLM policies and BMPs, required as COA, minimize and mitigate, to the extent possible, erosion from produced water surface discharge. Produced water is also generally hotter than naturally occurring surface water, and contains dissolved compounds that can be toxic to fish. Downstream from the discharge point, cooled produced water that has released some of its dissolved chemical components can have a beneficial impact on stream habitat.

Alternative A

Surface Disturbance

Surface disturbance results in adverse impacts to fish habitat by increasing soil erosion and sedimentation that degrades water quality. Alternative A is anticipated to have short-term (136,415 acres) and long-term (15,710 acres) surface disturbance over the life of the plan (Table 4-1) causing erosion rates of 568,166 and 25,176 tons per year, respectively, that would contribute to sedimentation. Surface-disturbing activities are prohibited within 500 feet of surface water or riparian/wetland areas to minimize potential water quality impacts. Relative to the other alternatives, Alternative A includes the second fewest restrictions on activities that remove vegetation and compact soils, resulting in more storm water runoff entering streams.

Resource Uses

Under Alternative A, 4,033,195 acres are available for locatable mineral entry, 4,052,688 acres are open for oil and gas leasing, and 3,975,695 acres are open to mineral materials disposal. Alternative A closes areas encompassing 46 miles of fishbearing streams to locatable mineral entry (Table 4-9). There would be some oil and gas development in areas that drain into fishbearing streams, although there are 35 miles of fishbearing streams in areas closed to oil and gas development under Alternative A (Table 4-9). This alternative is anticipated to result in the development of 1,130 new federal wells, and produced water may impact fish habitat by changing flow regimes and contributing to sedimentation.

Under Alternative A, the BLM limits motorized vehicle use to existing roads and trails on 2,332,355 acres. Motorized vehicle use is likely to contribute to sedimentation in areas where existing roads and trails are in close proximity to, or cross, rivers and streams. Allowing off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations may result in new roads and trails that would impact fish where they cross rivers or streams or increase sedimentation. Alternative A closes 59,192 acres to motorized vehicle use and limits it to designated roads and trails in The Rivers SRMA and in areas with fragile soils, reducing adverse impacts from erosion and sedimentation.

Recreation sites (e.g., campgrounds, day use areas) are developed as demand warrants under Alternative A. Campground and recreational facility development in riparian/wetland areas can degrade water quality by removing vegetation and increasing erosion and sedimentation. The increased angler access provided by recreation facilities near water courses can also directly impact fish habitat (e.g., trampling of banks and stream bottoms, accidental fuel/chemical spills). Alternative A provides for and emphasizes opportunities for recreational access to rivers and streams, potentially causing adverse impacts to fish habitat.

Forest management under Alternative A allows for the third highest degree of vegetative treatment, including clear cuts, precommercial thinning, woodland treatments in aspen and juniper stands, and prescribed fire, that could contribute to soil disturbance and sedimentation in streams and rivers in the short term. However, Alternative A uses treatments and timber harvests to improve forest health; most of these treatments may decrease the probability of stand replacing wildfires that can cause erosion and sedimentation, and therefore benefit fisheries in the long term.

Special Designations

Special designations under Alternative A that protect riparian habitat and water quality by restricting surface-disturbing activities include the Carter Mountain, Five Springs Falls, and Upper Owl Creek ACECs, in total encompassing 29 miles of fishbearing streams (Table 4-9). Under this alternative, water impoundments, major diversions, or hydroelectric power facilities are prohibited on all WSR eligible waterway segments. These segments are closed to mineral materials disposal; however, many remain open to mineral leasing and the associated adverse impacts to water quality and quantity. This management in special designations would mostly result in beneficial impacts to fish habitat; however, there also may be an adverse impact because NWSRS management under Alternative A may limit native species restoration activities.

Resources

Alternative A uses treatments and timber harvests to improve forest health; most of these treatments may decrease the probability of stand replacing wildfires that can cause erosion and sedimentation, and result in beneficial impacts to fish habitat in the long term. Riparian/wetland areas are managed to meet or make progress towards meeting PFC under Alternative A, providing long-term benefits to water

quality. The prohibition of surface-disturbing activities within 500 feet of riparian/wetland areas provides beneficial impacts to fish habitat by reducing sedimentation into streams and reducing stream bank degradation. Alternative A does not fence wetlands or riparian areas to meet resource objectives, leaving these areas vulnerable to potential impacts from other resource uses or activities and potential degradation of fish habitat.

Proactive Management

Direct beneficial impacts to fish as a result of proactive management under Alternative A result from encouraging reservoir design to establish minimum pools sufficient to maintain viable fisheries, intensively managing intermittent streams and restoring streams and fisheries habitat on a case-by-case basis, and managing fisheries habitat to improve and enhance its value (e.g., vegetation planting and installing sediment and erosion control structures).

Alternative B

Surface Disturbance

Impacts on fish habitat from surface disturbance would be similar to those described under Alternative A, although to a lesser degree due to decreased surface disturbance. Management under Alternative B would result in less surface disturbance over the short term (73,919 acres) and long term (10,882 acres) resulting in approximately 45 percent and 31 percent less erosion than Alternative A in the short and long term, respectively. Compared to Alternative A, fewer opportunities exist for surface-disturbing activities, including oil and gas and ROW development in areas that contain fishbearing streams (Table 4-9). More areas are designated as having NSO and CSU restrictions along perennial streams, riparian areas, and waterbodies under this alternative. Alternative B prohibits surface-disturbing activities and surface occupancy within ¼ mile of Class 1 and 2 streams, providing the greatest beneficial impact to water quality and fish habitat compared to the other alternatives. Alternative B includes the most restrictions on activities that remove vegetation and compact soils, resulting in the least adverse impacts to fish habitat due to increased runoff.

Resource Uses

Minerals development under Alternative B would result in the least adverse impact to fish habitat from sedimentation and other potential impacts to water quality. This alternative closes the greatest area to locatable minerals and oil and gas development containing fishbearing streams (80 and 122 miles, respectively). Alternative B prohibits new surface discharge of produced water, which would limit beneficial impacts to stream habitat, but also potential adverse impacts from altered flow regimes and water chemical properties.

With the most area closed, the most area limited to designated roads and trails, and the least area limited to existing roads and trails, Alternative B would result in the least adverse impacts from motorized vehicle use to water quality, compared to the other alternatives. Prohibiting off-road motorized vehicle use for big game retrieval in areas with limited travel designations would limit adverse impacts to fish from new trail and road proliferation that may impair water quality. Heavily eroded or washed out roads, if alternative routes exist, are closed and reclaimed and all channel crossings are photo point monitored, providing long-term beneficial impacts to water quality. Campgrounds are not developed under Alternative B, resulting in less adverse impacts due to recreation access than alternatives A and C. However, opportunities for recreational access to some rivers and streams, such as the Laddie Creek and Paint Rock Creek areas, are expanded under this alternative, augmenting potential adverse impacts to fish habitat in these areas.

Forest management actions under Alternative B primarily utilize natural processes to meet forest health goals over commercial thinning or harvesting practices, prohibit clear cuts, and retain old growth forest areas over a 30-year period in HUC Level 4 sub-basins, unless altered by natural processes. Forest management under Alternative B may result in the least amount of short-term adverse impacts to fish habitat due to sedimentation, but also may result in the greatest risk of wildfire that may degrade fish habitat.

Special Designations

Management in special designations under Alternative B would result in the greatest beneficial impacts to fish habitat compared to the other alternatives. Special designations that protect riparian habitat and water quality by restricting surface-disturbing activities include the expanded Carter Mountain, Five Springs Falls, and Upper Owl Creek ACECs, and the proposed Chapman Bench, Clarks Fork Canyon, Rattlesnake Mountain, and Sheep Mountain ACECs, including a total of 43 miles of fishbearing streams (Table 4-9). Under Alternative B, all WSR eligible waterway segments are recommended as suitable for inclusion in the NWSRS, containing 51 miles of fishbearing streams. These segments are closed to locatable mineral entry, mineral leasing, geophysical exploration, and all surface-disturbing activities, providing the greatest amount of protection for water quality and fish habitat for these segments, compared to alternatives A, C, and D. However, there also may be an adverse impact because NWSRS management under Alternative B may limit native species restoration activities, similar to Alternative A.

Resources

The BLM manages riparian/wetland areas toward achieving DPC and stabilizes watershed improvement projects to prevent the release of stored sediment if projects no longer meet resource needs, providing the greatest long-term benefit to fish habitat compared to the other alternatives.

Alternative B maintains natural flow regimes in streams supporting fish, providing the greatest beneficial impacts to water quantity compared to the other alternatives. Fencing of wetlands and riparian areas reduces potential bank degradation and sedimentation from other activities and resources uses, resulting in greater indirect beneficial impacts to fish than Alternative A.

Proactive Management

Direct beneficial impacts to fish as a result of proactive management under Alternative B result from restoring important stream segments for fish habitat on 10 lotic miles and 80 lentic acres. Alternative B not only improves existing fish habitat on BLM-administered land, but implements management practices to acquire, develop, and maintain new water sources. Alternative B requires mitigation that includes minimum pool depths and adequate public access routes for new impoundment construction on BLM-administered land, and designs and retrofits culverts to allow fish passage. Alternative B provides the greatest amount of proactive management to protect and restore fish habitat.

Alternative C

Surface Disturbance

Impacts to fish habitat from surface disturbance would be similar to those described under Alternative A, although to a greater degree due to increased surface disturbance. Management under Alternative C would result in 245,783 acres of short-term surface disturbance and 41,545 acres of long-term surface disturbance (Table 4-1) resulting in 80 percent and 164 percent more erosion in the short and long term, respectively, than Alternative A. Alternative C provides less restriction on surface-disturbing activities

and minerals development, potentially affecting more miles of fishbearing streams, and would cause the greatest impacts to water quality compared to the other alternatives.

Resource Uses

Alternative C may result in the greatest amount of change to surface water quantity because the BLM projects the most new federal wells (1,247) and fewer miles of fishbearing streams are in areas closed to minerals development (Table 4-9). Under this alternative, the BLM may not maintain natural flows but encourages water development projects with adequate and required in-stream flow features to maintain and support fish habitat values. The BLM also uses produced water – in accordance with federal, state, and local laws and regulations – to enhance fish habitat.

With the least area closed (10,636 acres), and the most area open (14,873 acres) to motorized vehicle use, Alternative C is anticipated to result in the greatest adverse impacts from OHV use to water quality compared to the other alternatives. Allowing off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations would result in impacts similar to Alternative A. Allowing motorized vehicle use on existing roads and trails in The Rivers SRMA would cause greater adverse impacts to fish habitat in this area than the other alternatives. Stabilizing heavily eroded or washed out roads and trails would cause greater short-term surface disturbance and potential sedimentation than the other alternatives. The water quality impacts from recreational development under this alternative are similar to Alternative A. The BLM would not emphasize opportunities for recreational access to certain rivers and streams under this alternative, limiting potential adverse impacts to fish habitat from recreational use. The BLM manages livestock grazing to optimize commodity production while meeting rangeland health standards, not to provide for the enhancement of other resources, and allows the placement of salt, mineral, or forage supplements to maximize livestock use, regardless of proximity to riparian/wetland areas, resulting in the greatest potential impact to water quality under this alternative.

Forest management actions under Alternative C generally prioritize resource use over forest health, although Alternative C provides for retaining old growth forests, similar to Alternative B. Logging, timbering, salvage, and silviculture techniques are used to maintain a desirable forest condition that is determined primarily by commercial or economic objectives. Alternative C allows clear cuts up to 100 acres, which would result in greater adverse impacts to water quality than under alternatives A and B.

Special Designations

Spanish Point Karst (designated under all alternatives) is the only ACEC that benefits water quality by restricting surface-disturbing activities and pesticide application; the only other ACEC designated under Alternative C, Brown/Howe Dinosaur Area, is managed to mitigate surface-disturbing activities, but generally allows mineral development and other types of surface-disturbing activities. Under this alternative, none of the WSR eligible waterway segments are recommended as suitable for inclusion in the NWSRS; these areas would be released to other uses and no special management actions would be applied. Under Alternative C, special designations do not provide any substantial beneficial impact to surface water quality or fisheries habitat.

Resources

Riparian/wetland areas are managed to achieve PFC, similar to Alternative A; however, Alternative C emphasizes those areas functioning at-risk with a downward trend or in nonfunctioning condition. Alternative C would provide fewer benefits to fish habitat than Alternative B because watershed improvement projects would be stabilized on a case-by-case basis. In addition, Alternative C has the most potential to adversely impact fish habitat because it would allow surface-disturbing activities in

riparian/wetland areas and floodplains on a case-by-case basis. Allowing these types of activities could cause bank degradation, sedimentation, and changes to water quality.

Encouraging water developments that enhance adequate in-stream flow would result in beneficial impacts to fish habitat under Alternative C; however, these impacts may be less than alternatives A and B. Fencing of springs and their associated wetlands reduces bank degradation and sedimentation in site-specific areas, resulting in indirect beneficial impacts to fish habitat in those areas and potentially downstream of those areas. These beneficial impacts are anticipated to be less than alternatives B and D, but greater than Alternative A.

Proactive Management

The direct beneficial impacts to fish from proactive management under Alternative C are less than under the other alternatives. Restoration efforts of stream segments and fisheries habitat are the same as Alternative A. In general, Alternative C only manages to improve fish habitat or maintain viable fisheries in accordance with required law or policy, while some management actions under alternatives A and D and all management actions under Alternative B surpasses these requirements.

Alternative D

Surface Disturbance

Impacts to fish habitat from surface disturbance would be similar to those described under Alternative A. Alternative D is projected to result in slightly more short-term surface disturbance (Table 4-1) that is estimated to result in a 3 percent and 17 percent increase in erosion in the short and long term, respectively. However, reclamation practices under this alternative, as they are more stringent than those under Alternative A, may limit soil erosion to a greater degree resulting in fewer adverse impacts to fishbearing streams. Additionally, Alternative D provides more restrictions on surface-disturbing activities and minerals development that could affect fishbearing streams than Alternative A.

Resource Uses

Minerals development under Alternative D would result in similar adverse impacts to fish habitat as under Alternative A, but to a greater degree. Alternative D closes more area to oil and gas development that drains into fishbearing streams than Alternative A, but less area to locatable minerals development. Since a greater amount of surface disturbance is projected to result from locatable minerals development, Alternative D may result in greater adverse impacts to fish habitat from minerals development than Alternative A. Alternative D is anticipated to develop fewer new federal wells than alternatives A and C, but more than Alternative B with proportional adverse impacts to water quantity that may affect fish habitat.

Travel and transportation management under Alternative D would result in less adverse impacts than alternatives A and C, but more than Alternative B. Motorized vehicle use under Alternative D would result in less adverse impacts than Alternative A, because the BLM closes a similar amount of acreage to motorized vehicle use but limits 34 percent more area to designated roads and trails. More lands are open to cross-country motorized travel, but these areas are not in close proximity to fish habitat and would not result in direct adverse impacts. Restricting off-road motorized and mechanized travel for big game retrieval to within 300 feet of established roads provided there is no resource damage and no new routes are created would result in less adverse impacts to fish habitat than Alternative A. Potential adverse impacts from recreational access to fish habitat, such as the Paint Rock, Laddie, and Canyon Creeks and the North and South Forks of the Shoshone River would result in similar adverse impacts to

alternatives A and B, but to a greater degree. Impacts to fish habitat from recreational development and livestock grazing management under Alternative D would be similar to those under Alternative A.

Forest management actions under Alternative D would result in impacts similar to Alternative A, except for allowing clear cuts up to 100 acres, which would result in adverse impacts similar to Alternative C.

Special Designations

Special designations under Alternative D would result in similar beneficial impacts as those under Alternative A, but to a greater degree from closing the Upper Owl Creek and Five Springs Falls ACECs to oil and gas leasing. Designating the Clarks Fork Canyon ACEC would result in beneficial impacts by protecting additional fish habitat under Alternative D. By not recommending any of the WSR eligible waterway segments as suitable for inclusion in the NWSRS, Alternative D would result in fewer beneficial impacts from fish habitat protection afforded by this special designation under alternatives A and B; however, Alternative D would result in fewer limitations to native species restoration activities.

Resources

Riparian/wetland resources management under Alternative D would result in similar beneficial impacts to those under Alternative A, but to a greater degree. More adverse impacts may result to fish habitat by encouraging the maintenance of natural flow regimes only in prioritized streams; however, developing watershed improvement practices similar to those under Alternative B plus applying BMPs in cooperation with stakeholders would result in greater beneficial impacts than under Alternative A. Fencing reservoirs and riparian areas would result in similar beneficial impacts as those under Alternative B. Surface-disturbance restrictions around waters of the state and riparian/wetland areas would result in similar beneficial impacts to those under Alternative A.

Proactive Management

Direct beneficial impacts to fish as a result of proactive management under Alternative D would be similar to those under Alternative A, although to a greater extent. Avoiding surface-disturbing activities around WGFD-rated Class 1 or 2 fisheries up to ¼ mile would likely result in greater beneficial impacts than alternatives A and C. Intensively managing perennial streams to become fish habitat, restoring important stream segments for fisheries habitat on a priority basis, encouraging minimum pool management in existing reservoirs, and designing or retrofitting culverts to allow fish passage on a priority basis would result in beneficial impacts similar to, or greater than, those under Alternative A.

4.4.6 Fish and Wildlife Resources – Wildlife

Adverse impacts to wildlife include removal, degradation, or fragmentation of wildlife habitats. Beneficial impacts include actions that conserve or improve habitats, such as big game crucial winter range or nest sites.

Direct impacts to wildlife would result from loss of habitats or from immediate loss of life. Wildlife can be directly disturbed by human activities (e.g., motorized vehicle use, recreation), potentially causing wildlife to abandon a nest site or home range. Disturbance during sensitive periods (i.e., winter, nesting) may adversely impact wildlife populations. The impact from disturbances may be short-term, where the population may be displaced or shift its activities, or long-term, where the population may permanently abandon its home range, threatening its viability. Habitat loss and fragmentation can result from vegetation treatments, fire and fuels management, mineral exploration and development, construction and maintenance of roads and trails, and development of wind-energy facilities.

Indirect impacts to wildlife result from changing habitat characteristics or habitat quality that affect wildlife. Surface-disturbing activities and other actions that remove vegetation and disturb soil can alter habitat quality. Indirect impacts to wildlife also result from actions that alter habitats to make them unsuitable for future habitation by wildlife species.

4.4.6.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- The BLM, in cooperation with state and other federal wildlife agencies, is responsible for managing habitat (e.g., quality, suitability, usability), whereas state and federal wildlife management agencies (e.g., WGFD, USFWS) have primary authority for overseeing management of wildlife populations. Therefore, this analysis primarily relies on vegetation changes and loss of habitat use due to disruptive activities to estimate impacts to wildlife habitats.
- For each alternative, changes to vegetation types, either in quantity, quality, or increased fragmentation, are compared to baseline conditions. Adverse and beneficial impacts to vegetation types (i.e., wildlife habitats) are assumed to have a corresponding adverse or beneficial impact on wildlife species.
- Disturbance impacts to wildlife are evaluated by comparison to current management practices in the Planning Area; increased protection in time or space are beneficial, whereas reduced protection result in adverse impacts.
- Disturbance during sensitive periods adversely affects wildlife.
- Habitat fragmentation adversely affects wildlife.
- Prescribed fire, where historical fire regimes occurred, is a tool used to manage vegetative communities and can result in short-term adverse impacts with long-term beneficial impacts to wildlife, certain wildlife habitats, and in some cases to forage productivity and availability.
- Forest management actions replicating natural historical disturbance regimes and managing wildlife habitats instead of, or in addition to, managing forest products are anticipated to benefit wildlife habitats.
- Management actions aimed at benefiting specific wildlife species can have adverse or beneficial impacts to other wildlife species.
- Alternatives with a larger number of acres of wetlands developed or protected will exhibit a greater benefit to waterfowl and other riparian/wetland wildlife species when compared to alternatives with smaller acreage of wetlands developed or protected.
- Alternatives providing more protection of water sources beneficial to wildlife are anticipated to have the greatest benefit to wildlife.
- Surface disturbance generally causes adverse impacts to wildlife habitats. Lesser amounts of surface disturbance in wildlife habitats have a corresponding lesser adverse impact to wildlife compared to more surface disturbance. The extent of adverse impacts due to surface disturbance depends on the precipitation zone.
- Prohibiting surface disturbance or occupancy is more restrictive and provides more protection for wildlife than avoiding surface disturbance or occupancy.
- The more surface disturbance that occurs on steep slopes or on highly erosive soils, the greater the potential for adverse impacts to wildlife habitats. Adverse impacts from surface disturbance also increase in areas that receive less precipitation.

- The higher the road density and the frequency of use in the Planning Area, the greater the potential to degrade adjacent wildlife habitat quality in the Planning Area.
- The more area used by OHVs and the higher the density of motorized vehicle use, the greater adverse impacts are anticipated to wildlife habitats.
- The BLM utilizes the best available information, management and conservation plans, and other research and related directives, as appropriate, to guide wildlife habitat management on BLM-administered lands.
- The quality and quantity of seasonal ranges and migration corridors are generally considered to be the limiting factors on big game populations in the Planning Area. The ability of these areas to support populations is a factor in determining population levels.
- Natural variability in wildlife health, population levels, and habitat conditions would continue. Periods of mild or severe weather as well as outbreaks of wildlife disease or insects/diseases that impact habitat (e.g., bark beetle, blister rust, mistletoe, and bleeding rust) may impact wildlife population levels.
- Wildlife habitats being protected are generally in desired natural condition and those being managed are being managed toward a more desirable condition.
- Habitat vegetation that trends away from natural vegetation condition (due to increase in invasive species), similarly trends away from natural wildlife species composition.

4.4.6.2 Summary of Impacts by Alternative

The principle adverse impacts to wildlife result from surface disturbance related habitat loss and fragmentation; the principle beneficial impacts to wildlife result from management that restricts surface-disturbing activities in known or potential wildlife habitat and disruptive activities (e.g., motorized vehicle use, recreation) that can cause the abandonment of nest site or home ranges. Based on the actions and uses allowed, alternatives ranked in order of increasing potential adverse impacts and decreasing beneficial impacts to the wildlife categories presented in this section are B, D, A, and C. Alternative B includes the most management to minimize wildlife habitat loss and fragmentation, such as making areas administratively unavailable to oil and gas leasing, followed by D, A, and C respectively. Alternative C allows the most surface disturbance and resulting habitat degradation and loss, followed by alternatives A, D, and B. With the exception of limiting wind-energy development and ROW authorizations to a greater extent than Alternative A, Alternative C has the fewest measures with which to control habitat loss and fragmentation, followed by A, D, and B. Alternative B also designates the most ACECs and all LWCs as Wild Lands (571,288 acres), resulting in beneficial impacts to wildlife over a large area; Alternative D designates 52,485 acres as Wild Lands. Alternative C does not restrict surface-disturbing activities in most sensitive areas and has few actions to improve habitat quality. Alternative B has the most restrictions on motorized vehicle use during crucial wildlife periods, followed by alternatives C, D, and A. Under Alternative B, restricting motorized vehicle use and surface-disturbing activities in the Absaroka Front Management Area provides the greatest beneficial impacts to wildlife species, especially big game and predators. Less restrictive management is applied to the Absaroka Front Management Area under Alternative D, and under Alternative C, the area is managed consistent with other resource objectives, with the exception of limiting motorized vehicle use to designated roads and trails with seasonal limitations. The area is not managed as a Management Area under Alternative A.

The spread of invasive species adversely affects wildlife by displacing native vegetation and altering ecosystem function. Alternative B would slow the spread of invasive species the most because it is

projected to involve the least amount of surface disturbance and has the most stringent reclamation requirements, followed by alternatives D, A, and C. Vegetation treatments under Alternative C would result in the greatest amount of short-term surface disturbance, but if habitat loss and displacement of wildlife is temporary, this alternative may result in the greatest long-term benefit to wildlife by restoring fire adapted habitat and reducing the risk of catastrophic wildfire, followed by Alternative D. Alternative B would result in the least short-term disturbance to wildlife from prescribed fire and fuels treatment, but also would result in the greatest risk of large wildfire that would destroy wildlife habitat, followed by alternatives A, D, and C.

Alternative B includes the most improvements to habitat quality, provides for more measures to restrict activities that can damage soils and habitats, reserves the most forage for big game on crucial winter range, and sets aside the most land for ACECs with emphasis to benefit wildlife resources followed by alternatives D, A, then C (Table 4-9). Alternative C has minimal guidance to protect or improve habitat quality, and no ACECs are designated to conserve wildlife habitat. Alternative D would result in similar habitat improvement actions in riparian/wetland areas as Alternative C, but this alternative places greater restrictions on surface-disturbing activities in these areas than alternatives A and C and applies an NSO restriction on all wetlands greater than 20 acres, limiting potential adverse impacts from long-term surface disturbance to a greater extent. In general, Alternative D has similar measures to protect and improve habitat quality in grassland and shrubland communities as under Alternative B; however, under Alternative D, fewer ACECs are designated that would beneficially affect wildlife such as big game (Table 4-9). Forest management under Alternative D would cause impacts similar to Alternative A, except that allowing larger clear cuts may result in habitat loss for some species that prefer closed canopies. Seasonal restrictions on surface-disturbing activities around active raptor nests would affect the most forested habitat under Alternative B, followed by alternatives A, D, and C. In addition, alternatives B and D provide year-round CSU stipulations to protect approximately 47,731 acres of forested habitat. Alternative B provides the most protection from surface-disturbing activities for big game on crucial winter range and parturition habitat, followed by alternatives D, A, and C (Table 4-9).

4.4.6.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Surface Disturbance

The precise location of surface disturbance in the Planning Area resulting from implementation of the alternatives cannot be determined. Surface disturbance would occur in a variety of vegetation types all used as wildlife habitat by wildlife. Therefore, the BLM projects that the extent of impacts to wildlife from surface disturbance would generally relate to the amount of surface disturbance in the Planning Area. These activities will be evaluated further during project-specific NEPA evaluations before project authorization. As acreages of surface disturbance and human activity levels increase, the quality and quantity of wildlife habitats would decrease. Long-term surface disturbance accounts for reclamation of some lands following short-term disturbance. Although reclamation restores habitats, thereby reducing long-term surface-disturbance acreage, the location of permanent facilities (e.g., roads, well pads, etc.) adjacent to reclaimed areas may reduce the utility of reclaimed habitats. For example, the higher the density of permanent facilities in an area, the more a habitat is fragmented and the more adverse impacts anticipated for wildlife. In addition, reclaimed areas are more vulnerable to establishment of invasive species and would not initially provide the same level of habitat function, forage, or cover that the original vegetation provided. The timing and type of reclamation is also anticipated to result in impacts to wildlife.

As discussed in Chapter 3, habitat fragmentation occurs when a contiguous habitat is intersected, divided, or segmented by surface disturbance. Fragmentation causes a reduction in usable ranges and the isolation of smaller, less mobile species; a loss of genetic integrity in species or populations; and an increase in abundance of habitat generalists characteristic of disturbed environments (i.e., competitors, predators, and parasites) (Harris 1984). As disturbance reduces the size of contiguous habitat patches, density dependency thresholds of suitable habitats for species may be met, which ultimately may decrease population size and increase disease frequency.

Resource Uses

The principle impacts to wildlife species (especially big game) from minerals development in the Planning Area would be the reduction in usable wildlife habitat and disruption of migration corridors that link seasonal ranges. In areas with continuous surface disturbance, the adverse impacts would be greater.

Impacts from locatable minerals development would include displacement of wildlife from developed areas and avoidance of a larger area around the development because of human presence and noise. Increased bentonite mining, and potentially gypsum mining, along with difficulty in shrub reclamation in the 5- to 9-inch precipitation zone would result in a reduction of sagebrush habitat across all alternatives. Salable minerals extraction would result in short-term, direct impacts to wildlife and associated habitat. Impacts would include displacement and disturbance of animals, removal of vegetation, and loss of habitat. The level of impacts would depend on the size of the salable minerals area and the importance of the altered habitat to wildlife.

Oil and gas development would result in adverse impacts to wildlife habitat. As the number of wells, roads, and facilities increase, habitats in and near well fields, due to degradation, invasive species spread, and fragmentation, may become less suitable until most animals no longer use these areas. Due to prolonged reclamation time, oil and gas development in the 5- to 9-inch precipitation zone may result in long-term impacts from habitat removal and fragmentation. Animals that remain in the affected zones are subjected to increased physiological stress. This avoidance and stress response impairs habitat function by reducing the capability of wildlife to use the habitat effectively. In addition, physical or psychological barriers lead to fragmentation of habitats, further limiting the availability of suitable habitat. An area of intensive activity or construction becomes a barrier when animals cannot or will not cross it to access otherwise suitable habitat. These impacts are especially problematic when they occur within limiting habitat components such as crucial winter ranges and reproductive habitats (WGFD 2009). Studies have shown that actions involving increased human presence have adversely impacted wildlife populations such as mule deer and elk (Freddy et al. 1986; Phillips and Alldredge 2000; Shively et al. 2005).

Many sand and gravel areas are associated with riverine and alluvial plains; their development would impact these areas. The vegetative communities associated with these areas would be affected by the extraction of salable minerals. Salable mineral extraction may lower the water table, resulting in the potential loss of cottonwood communities typically associated with these minerals. Nesting birds such as great blue herons, bald eagles, and habitat for numerous waterfowl and neotropical migrants, and big game during the winter, depend on these communities.

Due to the projected surface disturbance and difficulty in reclamation, especially in arid areas, invasive species would continue to spread under all alternatives. Management actions may prevent the reoccurrence and spread of invasive and noxious weeds to maintain the native vegetative species that provide wildlife forage and habitat. Certain species of noxious weeds are poisonous and potentially fatal to some wildlife species. Prevention and treatment of invasive species would maintain or improve plant

community health, thereby benefitting wildlife. Surface disturbance, new road construction, off-road motorized vehicle use, and livestock and wildlife grazing contribute to the spread of invasive species.

Impacts on wildlife from land use authorizations (including ROWs) would depend on (1) the location of the authorizations, and (2) the success of reclamation and mitigation of disturbed lands. Impacts to wildlife habitat would vary with the specific type and location of the requested ROW. There would be short-term impacts from the construction of pipelines, buried fiber-optic lines, and other subsurface actions. However, proper reclamation would restore some level of habitat function in these areas. Depending on the locations of these actions and the long timeframes required for some disturbed sites to return to pre-disturbance vegetation cover, some impacts would be long-term. Aboveground ROW actions, such as communication sites, powerlines, and wind turbines would have long-term impacts. These types of permanent structures are particularly hazardous to avian wildlife because of the potential for collision or electrocution (Erickson et al. 2005).

Unless otherwise specified, motorized vehicle use is limited to existing roads and trails on BLM-administered land. Existing roads and trails may be maintained for continued access. CTTM plans address maintenance of roads, ways, and trails at a site-specific level. Limiting motorized travel to existing roads and trails would result in beneficial impacts to multiple wildlife species by enhancing and increasing security areas where roads are sparse or nonexistent.

Motorized vehicle use management that result in increased human presence would have a localized impact on wildlife. Impacts would include increased displacement of wildlife, increased stress during important time periods (e.g., winter, nesting), and degradation of habitats. Motorized vehicle use may alter the seasonal use patterns of many wildlife species. The use of motorized over-snow travel on winter range may lead to wildlife disturbance, causing additional stress. New roads created from OHV use would result in disturbance to wildlife in areas that normally do not contain human presence and habitat degradation through vegetation loss. Vehicle-wildlife collisions may increase in areas of high wildlife use and high human activity. Closure and reclamation of unnecessary roads would reduce fragmentation and restore habitat integrity while reducing the potential for wildlife disturbance.

Recreational activities (e.g., hiking, biking, camping, hunting, sightseeing) that result in increased human presence would cause localized impacts to wildlife. These activities would result in increased human presence, which may cause habitat degradation or wildlife disturbance (e.g., dispersal or avoidance). Human disturbance of big game may result in increased energy costs for the alerted animal, either from stress (preparation for flight [i.e., locomotion]) or from flight itself. An animal that has fled or is displaced incurs additional costs through loss of food intake and potential displacement to lower quality habitat. The cumulative energy costs of frequent disturbances may affect survival or reproductive success, especially during seasonally sensitive periods (e.g., winter, parturition, breeding, nesting, and early brood-rearing). Phillips and Alldredge (2000) and Shively et al. (2005) demonstrated a 30 percent reduction in elk calf recruitment from an activity as benign as simulated recreational hiking imposed during the calving season. If recreational activities were perform on noncrucial habitats or during seasons when sensitive wildlife species are not present and in compliance with recreation management actions, impacts would be minimal.

Livestock and wild horse grazing affects wildlife habitat due to competition for forage and habitat use and alteration. Stock driveways affect wildlife habitats by reducing vegetation and compacting soils from concentrated high levels of livestock use. Intensive livestock use can cause near-complete removal of vegetation. Due to this concentrated use, stock driveways may no longer provide forage or shelter for wildlife. If grazing occurs during the late or post-growing season, residual vegetation that would be necessary on big game winter ranges may be removed. This may also affect the availability of nesting cover for some birds the following spring. While there may be adverse impacts to some wildlife species

from livestock grazing, there are also beneficial impacts to other species. Certain grazing disturbances can enhance forage and habitat conditions for wildlife and regrowth areas may result in increased palatability of forage.

Wyoming Guidelines for Livestock Grazing Management and other appropriate BMPs would enhance rangeland health, improve forage for livestock, and meet other multiple use objectives. Appropriate grazing management with an emphasis on *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N), especially in the 5- to 9-inch precipitation zone where rangeland health is sensitive to grazing timing and intensity, will be required in all cases and would be beneficial to wildlife species.

Special Designations

Special designations that conserve vegetation and restrict surface-disturbing and other activities that adversely impact special status wildlife species, such as mineral development, motorized vehicle use, and ROW development would result in beneficial impacts by preventing disruptive activities in sensitive habitats, and limiting habitat loss, fragmentation, and degradation. Under all alternatives, WSAs are managed for naturalness, outstanding opportunities for solitude, and primitive and unconfined recreation under the IMP, and loss or alteration of wildlife habitat would be minimized in these areas. WSAs would benefit wildlife and their habitats by restricting surface-disturbing and other disruptive activities and preserving wilderness characteristics. Conversely, managing WSAs requires the use of natural processes to the extent possible and generally does not allow surface-disturbing activities designed to benefit wildlife habitat, such as vegetation treatments; WSAs may, therefore, result in adverse impacts to wildlife habitat that would benefit from such treatments. ACECs also benefit wildlife species by restricting surface-disturbing and other activities. The Spanish Point Karst ACEC, designated under all alternatives, is likely to result in beneficial impacts to special status bat species by restricting resource uses and activities that may impact roost habitat. Further analysis is provided in the discussions for each special designation according to the alternative.

Wildlife are likely to react to management and allowed uses by altering their behavior (e.g., changing migration routes or dispersal patterns). Restricting resource uses and activities in special designations and various management areas on BLM-administered land will have uncertain impacts to private lands from wildlife. Wildlife may leave private lands if BLM-administered lands provide more suitable habitat. However, if habitat protection on BLM-administered lands is sufficient to foster increases in wildlife populations, greater numbers may disperse to private lands.

Resources

All alternatives provide some degree of protection to streams, wells, springs, or other water sources by prohibiting or managing surface disturbance within varying distances from water sources. Those alternatives providing the greatest protection of water sources beneficial to wildlife species are anticipated to have the greatest benefit. Wildlife species that use water sources and riparian/wetland habitats in the Planning Area benefit from management actions common to all alternatives that promote the development and enhancement of water sources. The management of riparian/wetland areas to meet PFC and the *Wyoming Standards for Healthy Rangelands* (Appendix N) would improve habitat conditions for various wildlife species. Areas managed to higher standards (e.g., DPC), would result in additional benefits to wildlife.

Prescribed fire and wildfire would have both short-term and long-term impacts to wildlife. Short-term impacts include displacement from habitats, potential disturbance or loss of life for small game and ground nesting birds, and removal of vegetation and forage. The BLM generally conducts prescribed

fires outside of the nesting season (depending on elevation, approximately April 15th through July 15th), which would limit direct impacts to nesting birds. Any fire would cause some loss of less-mobile wildlife and not able to avoid the path of the fire. Fire line construction, use of heavy equipment, and other fire suppression activities would damage or destroy vegetation and habitat for wildlife. Timely rehabilitation of these activities is important to maintaining the quality of wildlife habitats. If rehabilitation is not completed, fire suppression activities can cause erosion or the potential spread of invasive species, which results in long-term adverse impacts to wildlife habitat.

Over the long term, fire would generally improve habitat conditions for most wildlife species. Fire can improve the quality of wildlife habitat conditions by releasing soil nutrients, reducing fuel load, or setting back species such as trees that may be encroaching on other habitats such as grasslands and shrublands. Fire would reduce dense understory that has mixed values for various species of wildlife. In vegetative climax communities, fire would return the vegetative community to an earlier stage of succession, increasing forage and cover for a greater diversity of wildlife. Fire can remove excess dead and dying vegetation, reduce hiding cover for prey species and potential thermal cover in the winter months. However, post-fire log and limb fall would increase horizontal cover and may produce snags important for nesting birds in the long term. The extent of impacts to wildlife from fire depends on the extent of change in habitat structure and species composition the fire causes. Resident and neotropical migrant bird species would be directly affected by loss of habitat from wildland fires. The duration of habitat loss would depend on the types of vegetation removed and the fire severity.

Forest management practices would change the seral stage of the affected stands. Many forest management practices are designed to alter or set back the seral stage of the forest community. These activities may increase wildlife species diversity and richness, depending on different species' habitat requirements. Properly mitigated commercial forest management may improve big game habitat in the long term by improving forest age class diversity and distribution, edge effect, and forage community diversity. Conversely, commercial forest management may take important habitat components (e.g., snags, dead and down components, and the largest trees) out of the ecosystem and result in adverse impacts to species that depend on these components. Amphibians, reptiles, and other smaller animals depend on these habitat components for survival, while species such as the snowshoe hare are generally harmed through precommercial thinning practices (USFS 2005b). Properly mitigated commercial forest management would result in beneficial impacts to wildlife species that depend on diverse forest seral stages; however, such treatments may also put stands in a stable state where the forest structure does not mimic natural conditions in untreated parcels. Impacts to wildlife from forest management depend on the type of stand – mostly adverse impacts occur in spruce and subalpine fir stands, while mostly beneficial impacts would occur in aspen, Douglas-fir, and ponderosa pine stands. Habitat loss and fragmentation would be long-term adverse impacts from forest management; displacement of animals, noise disturbance, and increased vehicle traffic would be short-term adverse impacts.

Under all alternatives, the BLM constrains wild horse population numbers to the initial appropriate management level in existing HMAs (Map 36), such that their existing effect to wildlife habitat and populations would be sustained at the current level. Maintaining horse populations at initial appropriate management levels can still result in adverse impacts to wildlife habitat and populations. Wild horses graze areas in the McCullough Peaks and Fifteenmile HMAs on a year-round basis, competing with wildlife directly for some forage species and access to water.

Management actions for cultural and paleontological resources would provide varying degrees of habitat protection by minimizing vegetation loss and erosion and by restricting surface-disturbing

activities. If public interpretation facilities generate increased human presence during sensitive seasonal periods (e.g., breeding, nesting, or migration) wildlife could be disturbed.

Proactive Management

Wildlife habitat management would prevent or reduce impacts to wildlife species from surface-disturbing and other disruptive activities through implementing mitigation and BMPs, such as timing stipulations and designations of spatial buffers. These stipulations would provide some mitigation for loss of habitat function or habitat value for wildlife species.

Proactive management actions common to all alternatives that would benefit wildlife by conserving or improving habitat quality or reducing the likelihood of disturbance include prohibiting surface-disturbing and disruptive activities in the Bighorn River HMP/RAMP tracts and the BLM-administered tracts in Yellowtail Wildlife Habitat Management Area and applying an NSO restriction as appropriate; maintaining or improving important wildlife habitats through vegetative manipulations, habitat improvement projects, livestock grazing strategies and the application of the *Wyoming Guidelines for Managing Sagebrush Communities with Emphasis on Fire Management* (Wyoming Interagency Vegetation Committee 2002) and the *Wyoming BLM Standard Mitigation Guidelines for Surface-Disturbing Activities* (Appendix H); and continuing to use the existing West Slope, Bighorn River, and Absaroka Front HMPs, which contain numerous management actions for wildlife habitat enhancement.

Alternative A

Surface Disturbance-Alternative A

Alternative A would result in 136,415 acres of short-term surface disturbance that may degrade wildlife habitat and 15,710 acres of long-term surface disturbance that may result in habitat loss (Table 4-1). Minerals development, fire and fuels management, and silviculture treatments are the largest sources of short-term disturbance, with minerals development being the largest source of long-term disturbance. Alternative A requires that all surface-disturbing activities are analyzed for suitability and impacts and that vegetation cover is reestablished in disturbed areas within 5 years of initial seeding. These management actions would increase the probability of successful reclamation so that disturbed areas can return to suitable habitat in the long term. Heavily eroded or washed out roads are stabilized on a case-by-case basis, but not closed or reclaimed to return to wildlife habitat. Overall, the projected surface disturbance under Alternative A would result in adverse impacts to wildlife habitats, while associated reclamation practices would help to mitigate these impacts.

Resource Uses-Alternative A

Minerals development would be the greatest contributor to habitat loss and fragmentation. Under Alternative A, 4,033,195 acres are available for locatable mineral entry, which would result in approximately 10,000 acres of long-term disturbance and habitat loss (Appendix T). Under Alternative A the BLM places constraints on oil and gas leasing and expects the development of up to 1,130 new federal wells. The adverse impacts to wildlife from oil and gas development would be proportional to the actual number of new wells and the imposed constraints.

In general, land acquisition or disposal actions would be performed considering land tenure adjustment criteria with the goal that the exchange, acquisition, or disposal would increase the public benefits of BLM-administered resources, including wildlife resources. Any acquisition of nonfederal surface land that includes high value habitat may result in beneficial impacts to wildlife habitat by allowing for mitigation or restrictions for surface-disturbing and disruptive activities to maintain or enhance the habitat under BLM management. Any disposal of BLM-administered land that contains high value

habitat would typically be avoided as this may result in adverse impacts by increasing the potential for development without any required mitigation under BLM authority, and increased human presence would increase disturbance to wildlife utilizing the area. All land tenure actions would be analyzed on a site-specific basis, using a public process, to determine public interest before making a decision. Consolidating land ownership through land tenure adjustments would increase the manageability of lands and result in more contiguous blocks of habitat, which would result in beneficial impacts to wildlife. Under Alternative A, 116,800 acres are identified for disposal by sale, exchange, or other methods, with exchange being the preferred method.

Routing linear ROWs (e.g., pipelines, powerlines, roads) where impacts would be least disturbing would help to minimize fragmentation of sensitive habitats. Routing decisions would be determined with site-specific NEPA analyses before making decisions, and where possible, new utilities would be placed in existing ROW corridors. However, habitat fragmentation would still occur as more ROWs are sited and developed or as an existing ROW corridor is expanded. Under Alternative A, the BLM manages 61,416 acres as ROW exclusion areas, which occur in big game crucial winter range, big game parturition habitat, and greater sage-grouse Key Habitat Areas (Table 4-9), limiting adverse impacts to sensitive wildlife habitat.

Allowing wind-energy development throughout the Planning Area would create collision hazards for bats, greater sage-grouse, and other avian species. Large wind-energy fields also result in surface disturbance, which would permanently change the habitat structure of the wildlife inhabitants. The number of anticipated wind-energy developments is similar under all alternatives (Appendix T), with the location of wind-energy facilities likely to vary across alternatives. Alternative A considers the development of wind-energy facilities on a case-by-case basis consistent with the Wind Energy Programmatic EIS Record of Decision (ROD), which provides guidance to consider micrositing alternatives, but not broader habitat avoidance efforts, when assessing the impacts of proposed facilities. Based on the lack of general guidelines for siting wind-energy projects outside wildlife habitat or avian concentration areas that would be most affected by new turbines, wind-energy development may result in adverse impacts to wildlife under this alternative, though ROW management would limit these impacts.

Motorized vehicle use restrictions would limit the potential for the proliferation of unauthorized trails and related habitat degradation and wildlife disturbance. Limiting motorized vehicle use to designated roads and trails (787,626 acres) and closing areas to motorized vehicle use (59,192 acres) would help to protect wildlife from human-caused disturbances or to sustain habitat integrity and water quality by preventing vegetation loss or soil erosion and compaction. Permitting off-road motorized vehicle use for big game retrieval and access to dispersed campsites in areas with limited travel designations would increase the likelihood of wildlife disturbance and trail proliferation that may degrade and fragment habitat. Overall, motorized vehicle use with restrictions under Alternative A would result in adverse impacts to wildlife.

Recreational facilities may disturb habitat during construction and lead to increased human presence that can cause avoidance behavior in wildlife and subsequent displacement. Under Alternative A, the BLM develops or upgrades recreation sites (i.e., camping sites, interpretive educational areas, day use areas) and the associated amenities and facilities if demand warrants and enhances opportunities for primitive recreation. Alternative A would result in 350 acres of surface disturbance from recreational site development; the increase in human presence and impact to wildlife would be proportional to the amount of surface disturbance.

Managing livestock grazing systems to limit forage competition between livestock and wildlife for forbs, shrubs, and other desirable plants would aid in wildlife survival at crucial times of the year. Limiting

forage competition would be particularly important in the spring, when enhanced nutrition is essential following the demands on body reserves during the winter, and the fall, when high nutrient forage is more limited and animals are trying to build fat reserves (Vavra 1992). Livestock grazing can also affect residual grass cover for bird nests and forb diversity to benefit fledglings. Under Alternative A, the BLM manages livestock grazing to provide for protection or enhancement of other resource values and closes several areas, such as the Bighorn River tracts, to grazing. Alternative A prohibits the placement of forage supplements within ¼ mile of water or riparian/wetland habitats to limit potential adverse impacts from concentrated livestock grazing.

Special Designations-Alternative A

A detailed description of the beneficial impacts to wildlife from special designations, where most applicable, is included below. Special designations under Alternative A that would directly benefit wildlife species by conserving habitat include the Carter Mountain and Upper Owl Creek ACECs. ACECs designated under this alternative encompass 32,433 acres of big game crucial winter range and 12,612 acres of big game parturition habitat (Table 4-9). Managing WSR eligible waterway segments to protect their free-flowing characteristics and outstandingly remarkable values (ORVs) would beneficially impact riparian habitat for various wildlife species.

Resources-Alternative A

Under Alternative A, the BLM utilizes wildland fire to restore fire-adapted ecosystems and to reduce hazardous fuels. Alternative A would result in approximately 70,000 acres of surface disturbance from prescribed fire and mechanical fuels treatment (Appendix T). These management actions would cause short-term adverse impacts to wildlife through temporary habitat loss and disturbance, but rapid recovery of forage and enhanced palatability would benefit wildlife even in the first few years post fire. A greater long-term benefit from preventing catastrophic fire that may lead to extensive habitat loss would outweigh the short-term impacts. Alternative A would result in long-term beneficial impacts to wildlife from fire and fuels management.

Forest management actions may impact feeding, breeding, and sheltering of raptors and other forest-dependent species. Habitat fragmentation and degradation, increased human presence, and habitat access by competitor species that normally cannot use these areas may all impact these species, depending on whether the action is a harvest or thinning, where the access roads are constructed, the type of equipment used, and the rate of habitat rehabilitation. Under Alternative A, the BLM performs commercial forest management in a manner that protects and benefits, watershed, wildlife, and riparian/wetland habitat values with forest health as a primary concern. Properly mitigated commercial forest management would benefit wildlife by diversifying forest seral stages. The BLM restricts clear cuts to no more than 900 feet in any direction in important seasonal wildlife habitat and closes timber access roads on a case-by-case basis. Forest management under Alternative A would result in adverse impacts to wildlife that depends on old growth trees, snags, and downed trees, but also long-term beneficial impacts by reducing hazardous fuels, diversifying stands, and closing certain timber access roads, which ultimately improves habitat for wildlife.

Vegetation treatments may disturb wildlife and result in displacement in the short term, but in the long term, these treatments would benefit wildlife by improving habitat and controlling the spread of invasive species. Under Alternative A, the BLM manages at least 600,000 acres toward DPC objectives that would benefit wildlife and treats 2,000 acres to remove or control the spread of invasive species. The amount of invasive species spread, where seeds or plants are present, would be proportional with the total amount of surface disturbance. Alternative A requires livestock flushing on a case-by-case

basis, which may decrease the potential spread of invasive species, especially in grasslands and shrublands.

The BLM manages riparian/wetland areas to meet PFC under all alternatives including Alternative A. Although wildlife habitat would be improved with this management action, because the PFC assessment methodology does not incorporate the habitat requirements of wildlife, additional management would be necessary to ensure that habitats provide conditions suitable to meet the life history requirements of various wildlife species. Alternative A prohibits surface-disturbing activities within 500 feet of water and riparian/wetland areas, which would benefit wildlife by conserving vegetation and valuable habitat for multiple species.

Proactive Management-Alternative A

Proactive management measures that would benefit wildlife are described in detail below. Proactive management actions implemented on a case-by-case basis under Alternative A include determining wildlife seasonal protections for surface-disturbing and disruptive activities related to the maintenance and operation of developed projects, addressing traditional migration and travel corridors, and determining the appropriate DPC to manage vegetation in crucial winter range or parturition habitat. Beneficial impacts to wildlife would result from these actions under Alternative A.

Big Game-Alternative A

As identified in Chapter 3, big game in the Planning Area face certain challenges such as poor habitat conditions, habitat fragmentation, disease, increased development and urbanization, hunter access, and impacts to key forage species from livestock and wild horse grazing. Big game crucial winter range is more sensitive to forest management, road construction, and vegetative change than other seasonal habitats. Since crucial winter range is considered the “limiting factor” to these big game populations, modifications to habitat suitability can impact species survivability and viability (e.g., higher winter mortality, reduced reproductive success), ultimately leading to reductions in population size. This impact would be intensified in areas where crucial winter range is in degraded or poor condition.

Alternative A would result in 27,356 acres of surface disturbance due to minerals development and new road construction, which would result in correlated adverse impacts to big game, relative to the other alternatives. Although Alternative A applies a TLS stipulation to avoid surface-disturbing activities in big game crucial winter range and parturition habitat, disturbance is allowed in these areas. Big game have exhibited sensitivity to human activity and disturbance. Mule deer exhibit a stress response to disturbances associated with noise and activity up to 0.29 mile from the source (Freddy et al. 1986). Allowing surface disturbance, including wind-energy development, in big game crucial winter range and parturition habitat is likely to disturb and displace species such as mule deer in the short term. The WGFD estimates there would be adverse impacts to pronghorn from oil and gas development on at least 170 acres surrounding each well pad (WGFD 2009). The greater mobility and adaptability of these species to human activity and disturbed areas would prevent long-term population impacts. However, it is feasible that big game behavior or populations may be altered in the long term at some level of development. Alternative A closes approximately 2 percent and 7 percent of big game crucial winter range and parturition habitat, respectively, to locatable mineral entry and 3 percent of big game crucial winter range and parturition habitat to oil and gas development (Table 4-9), limiting adverse impacts in these areas. Alternative A also closes a small portion of big game crucial winter range and big game parturition habitat to livestock grazing (Table 4-9), increasing forage availability in these areas.

Alternative A does not restrict motorized vehicle use to designated roads and trails in big game crucial winter range or elk parturition habitat, which may adversely affect big game by increasing human access

and the probability of disturbance. However, opening areas to over-snow travel on a case-by-case basis is likely to benefit big game by restricting access to areas of big game crucial winter range. As a result of other resource concerns, 15,698 acres and 9,298 acres of big game crucial winter range are managed as closed or seasonally restricted for motorized travel respectively, while 510 acres and 398 acres of big game parturition habitat are managed as such. In these areas, the probability of vehicle caused disturbance would be lower.

Special designations would result in beneficial impacts to big game where they overlap big game habitat (Table 4-9) and restrict resource uses and activities that degrade big game habitat or can potentially disturb big game (e.g., oil and gas development and motorized vehicle use). Alternative A designates the Carter Mountain and Upper Owl Creek ACECs, which contain big game habitat and restrict motorized vehicle use and minerals development.

Proactive management actions under Alternative A result in multiple beneficial impacts to big game by conserving habitat values from potential impacts from oil and gas development (Freddy et al. 1986, WGFD 2009) and potential forage competition from livestock (Vavra 1992). Alternative A applies a TLS to avoid surface-disturbing and disruptive activities in big game crucial winter range (1,313,731 acres) from November 15 through April 30 and a CSU stipulation for big game migration corridors, narrow ridges, overlapping big game crucial winter range, and big game parturition habitat. Alternative A prohibits the following actions unless adverse impacts can be avoided or mitigated: livestock grazing in elk parturition habitat during the birthing season (May 1 through June 30), domestic sheep grazing on pronghorn crucial winter range, and water development for livestock in elk crucial winter range. The BLM restores 25 to 200 acres of aspen stands per year until 2,000 to 4,000 acres are under management under Alternative A, which would especially benefit moose and deer that prefer woody vegetation as forage.

Trophy Game-Alternative A

Black bears are most affected by management actions in forest and woodland habitats, which generally are not focused on providing habitat for this species. Management actions under Alternative A that would minimize adverse impacts to this species by conserving habitat values include forest management in a manner that protects and benefits watershed, wildlife, and riparian/wetland habitat values and restricting clear cuts to no more than 300 yards in any direction in important seasonal wildlife habitats.

As cougars are typically found in remote, rugged areas, motorized vehicle use restrictions in WSAs under this alternative would minimize potential adverse impacts to this species (USGS 2007). Although no specific management actions for cougars are identified, cougars would experience impacts similar to mule deer, as cougars generally utilize similar habitats as mule deer—their primary prey.

Furbearing Animals-Alternative A

No specific management actions for furbearing animals exist, but other management actions would affect these species. Badger, bobcat, and weasel are habitat generalists and actions in a variety of habitats would affect these mammals. Impacts to various vegetation types can be found throughout this section. Because there would be as adverse and beneficial impacts to these vegetation types, these wildlife species would experience similar adverse and beneficial impacts.

Under Alternative A, no specific management actions aimed at maintaining old growth forests and woodlands exist to promote habitat for furbearing animals such as the American marten and weasel, although any activities proposed are addressed at the site-specific level before harvest decisions. Alternative A does restore 25 to 200 acres of aspen stands per year, which would benefit the American marten.

Several furbearing species (i.e., beaver, mink, and muskrat) are most affected by management actions that impact riparian/wetland habitat or water availability. Impacts to these species are similar to the impacts discussed below in the *Nongame (Neotropical Migrants)* section for species that use riparian/wetland habitat. The BLM manages riparian/wetland areas to meet PFC or to make progress toward meeting PFC under all alternatives including Alternative A, which would improve habitat suitability for wildlife.

Predatory Animals-Alternative A

The BLM does not perform any specific habitat management activities for predatory animals. Regardless, predatory animals will be affected by BLM management actions for wildlife habitats. These animals are largely habitat generalists and actions in a variety of habitat types would affect these animals. Impacts to various vegetation types can be found throughout this section. Some predatory animals (i.e., coyote and red fox) are highly mobile and would be affected by management actions pertaining to motorized vehicle use and projected new road development (USGS 2007) (Appendix T). In addition, predatory animals are vulnerable to motorized vehicle disturbance and collisions.

Small Game-Alternative A

There are no specific management actions for small game under Alternative A, but other biological resources management actions would affect these species. Habitat fragmentation is an issue for small game populations because they tend to be especially disadvantaged by isolation (Temple 1985). Projected surface disturbance from minerals development and new road construction, second highest under Alternative A (Appendix T), would fragment small game habitat. Cottontail rabbits are habitat generalists and a variety of actions in all habitat types would affect rabbits. Snowshoe hare and red squirrel inhabit forests and woodlands. Allowing precommercial thinning in overstocked areas and regenerated timber sale areas under Alternative A may cause adverse impacts to snowshoe hares (USFS 2005b). Conversely, performing woodland treatments in aspen stands and regenerating 2,000 to 4,000 acres of aspen stands would benefit snowshoe hare by improving or creating more habitat. The northern flying squirrel occurs most commonly in riparian forests. The *Nongame (Neotropical Migrants)* section describes impacts to these habitats.

Game Birds-Alternative A

The BLM identifies modifying livestock grazing management, prescribed burning, installing water developments, and building roost structures (i.e., structures that provide protection from predators) as methods for improving habitats for upland game birds (BLM 1992b). Under Alternative A, there are no specific management actions for game birds that utilize grassland. Actions in grassland habitats, such as surface-disturbing activities, reclamation, invasive species control, and livestock and wildlife grazing, would affect these species. Adverse impact to game birds in grasslands under Alternative A would be proportional to overall surface disturbance (Table 4-1). Management actions in their preferred vegetation types would affect other game birds. Pheasants generally prefer habitat associated with riparian areas along river and stream corridors. Actions in forested areas and grass or sagebrush habitats would affect ruffed grouse and blue grouse. Actions in river bottoms, pine forests, and foothills habitats would affect wild turkeys. *Nongame (Neotropical Migrants)* describes impacts to these habitats.

Waterfowl-Alternative A

Although there are no specific management actions for waterfowl, other biological resource management actions, particularly those pertaining to water and riparian/wetland habitats would affect these species. The BLM manages riparian/wetland areas to meet PFC or to make progress toward

meeting PFC under all alternatives, but does not consider wildlife life history requirements when managing vegetation. As a result of livestock grazing management practices and existing wild horse numbers in HMAs, some riparian zones on public land adjacent to streams, small reservoirs, and ponds have been trampled. Alternative A closes Bighorn River tracts to livestock grazing and prohibits forage supplements within ¼ mile of water or riparian/wetland areas, which would minimize adverse impacts to waterfowl habitat from livestock grazing in these areas. The BLM can use produced water to develop and enhance waterfowl habitats under Alternative A, which would benefit these species.

Nongame (Raptors)-Alternative A

The BLM identifies declining habitat quantity and quality as the major causes of decreases in raptor populations (BLM 1992c). Buffer zones around active nests minimize disturbance impacts to raptors in the Planning Area. Under Alternative A, the BLM applies a TLS to prohibit any activity or surface-disturbing activity within ¾ mile of raptor nests from February 1 through July 31; ultimately protecting 338,731 acres surrounding raptor nests. Protective buffers help to minimize, but cannot completely prevent, impacts to raptors because most species are mobile beyond these buffers. The impact from habitat degradation and loss would be proportional to surface disturbance (Appendix T).

Wind-energy facilities can be a source of mortality for raptors because raptors can collide with wind tower blades. High mortality may result if wind towers are placed along a migration path or in nesting areas. Wind-energy facilities also result in habitat loss and human disturbance through construction and maintenance of wind towers and associated facilities. Alternative A manages the location of wind-energy facilities throughout the Planning Area on a case-by-case basis.

Nongame (Neotropical Migrants)-Alternative A

The BLM (BLM 1992c) states that viable nongame bird populations and biological diversity can be promoted by improving livestock management, prescribed burning, removal of invasive species, seeding, and erosion control. These actions are managed under Alternative A; however, prescribed burning is limited and the spread of invasive species is expected to continue under all alternatives, including Alternative A.

Wind-energy facilities may adversely affect all neotropical migrants, as discussed for nongame raptors. Wind-energy facilities, and other linear features (e.g., roads, utility corridors), fragment habitat. Fragmentation creates habitat edges, where studies have indicated that the success of nongame bird nests decline (Paton 1994). Livestock grazing management can affect nongame bird habitat. Inadequate livestock grazing management results in adverse impacts to riparian/wetland habitat (Belsky 1999), adversely affecting nongame birds in these areas (Taylor 1986). Likewise, heavy grazing reduces nongame bird species richness in grassland and shrubland habitat (BLM 1978). However, light to moderate intensity livestock grazing can increase plant species diversity (Manier and Hobbs 2007), which may beneficially impact nongame birds in grassland and shrubland communities.

Because of the diversity of bird species and habitat requirements, the descriptions of impacts are categorized under the following habitat guilds listed below: Forest and Woodland Species, Mountain Shrub Species, Sagebrush and Desert Shrub Species, Grassland Species, and Riparian/wetland Species.

Forest and Woodland Species – Alternative A requires forest management in a manner that protects and benefits watershed, wildlife, and riparian/wetland habitat values. Refer to Section 4.4.1 *Vegetation - Forests, Woodlands, and Forest Products* and Table 4-8 for a description of management actions and BLM-authorized activities that would impact forests or woodlands and would similarly affect neotropical migrant habitat in these areas. Allowing clear cuts up to a 900-foot radius would adversely impact neotropical migrant species that prefer closed canopies by reducing potential nest sites and fragmenting

habitat; however, other species preferring open canopies or forest edges would benefit. The creation of early successional habitat, as a result of clear cuts or wildland fire, can result in replacement of a mature forest bird community with a young forest bird community (Thompson III et al. 1993). There is evidence that the juxtaposition of different aged stands, which creates increased amounts of edge in a forest, may have an adverse impact by reducing the reproductive success of neotropical migrants (Thompson III et al. 1993). Alternative A allows harvest of some old-growth forests and allows salvage of dead stands with appropriate levels of snag retention to benefit wildlife following site-specific review under NEPA. Overall, forest management practices under Alternative A would result in long-term beneficial impacts to neotropical migrants in forest and woodland habitats that would outweigh the short-term adverse impacts.

Mountain Shrub Species – Under Alternative A, the BLM manages mountain shrub communities toward DPC objectives that emphasize watershed protection, and livestock grazing. This management action would improve habitat conditions for neotropical migrants that depend on mountain shrub habitats in these areas. Adverse impacts to mountain shrub communities would result from surface disturbance and invasive species spread, and would be proportional to projected surface disturbance.

Sagebrush and Desert Shrub Species – Species that utilize or depend on sagebrush habitats benefit from management actions for greater sage-grouse, as discussed in Section 4.4.9 *Special Status Species - Wildlife*. Alternative A applies a CSU restriction for ¼ mile around occupied greater sage-grouse leks and a TLS for nesting or early brood-rearing habitats within 2 miles of occupied greater sage-grouse leks. Because the breeding season and habitat of greater sage-grouse and neotropical migrants tend to coincide, many species of neotropical migrants benefit from this restriction.

Under Alternative A, the BLM manages salt desert shrub and basin grassland/shrub communities toward DPC objectives to emphasize watershed protection and livestock grazing. Surface-disturbing activities may result in habitat loss and fragmentation and reduced habitat quality, especially in the 5- to 9-inch precipitation zone due to the difficulty of successful reclamation and the potential spread of invasive species. Refer to Section 4.4.1 *Vegetation - Grassland and Shrubland Communities* and Table 4-8 for a description of management actions and BLM-authorized activities that would impact shrubland communities and would similarly affect neotropical migrant habitat in these areas.

Grassland Species – These species would be affected by actions in grassland habitats, such as surface-disturbing activities, reclamation, invasive species control, and livestock and wildlife grazing. Under Alternative A, the BLM manages foothills-mountain grassland/shrub and basin grassland/shrub communities toward DPC objectives to emphasize watershed protection and livestock grazing. Livestock grazing practices, though managed in accordance with the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming*, may not create the vegetation heterogeneity necessary to increase habitat suitability for neotropical migrants (Derner et al. 2009). However, habitat quality would be maintained in these areas to benefit neotropical migrants that depend on these habitats. Refer to Section 4.4.2 *Vegetation - Grassland and Shrubland Communities* and Table 4-8 for a discussion of management actions and BLM-authorized activities that would impact grasslands and would similarly affect neotropical migrant habitat in these areas. Due to its projected long-term surface disturbance and reclamation requirements, Alternative A would result in habitat loss and degradation in grasslands.

Riparian/Wetland Species – There are no specific management actions for neotropical migrants that use riparian/wetland habitats. However, other biological resource management actions, particularly those pertaining to water and riparian/wetland habitats, such as surface disturbance restrictions, livestock grazing and riparian area management, and special designations would affect these species. Refer to Section 4.4.3 *Vegetation – Riparian/Wetland Resources* and Table 4-8 for a description of management

actions and BLM-authorized activities that would impact wetlands and riparian areas and would similarly affect neotropical migrant habitat in these areas.

Nongame (Mammals)-Alternative A

Although there are no specific management actions for nongame mammals, other biological resource management actions would affect these species. Nongame mammals are found in a variety of habitats and are affected by management actions in the preferred vegetation type of each species. Impacts to the various vegetation types are described above for nongame neotropical migrants and are expected to similarly impact nongame mammals.

Although bats can utilize a variety of habitats, caves and abandoned mines are important features for most species. Bats that use caves for roosting, maternity colonies, or hibernation may be affected by recreational caving and surface-disturbing activities near caves, cliffs, or other rock features. Habitat alteration and modification, loss of roosting habitat, and toxic chemicals are threats to bat species in the Planning Area (Keinath 2004; Gruver and Keinath 2006; and Luce and Keinath 2007). Generally, the BLM manages natural caves to meet recreational demand while conserving cave resources and allows activity in abandoned mine land (AML) sites on a case-by-case basis under Alternative A. The Little Mountain ACEC designated under Alternative A would conserve important habitat used by bats, and the use of heavy equipment is restricted over important caves and cave passages in the Little Mountain ACEC to minimize disturbance. Pesticides (specifically insecticides) can result in direct bat mortality, adversely affect reproduction, and reduce the insect prey base (Keinath 2004; Gruver and Keinath 2006; and Luce and Keinath 2007). Aerial application of insecticides under Alternative A may result in direct and indirect adverse impacts to bats as these species are at risk from poisoning by insecticides due to their diet, high metabolic rates, high rate of food intake, and high rate of fat mobilization.

There are 43,114 acres of identified “badlands/rock outcrop” on BLM-administered land in the Planning Area that may contain potential bat habitats. These areas include the Medicine Lodge and Trapper Creek WSAs, where motorized vehicle use is limited to designated roads and trails under Alternative A, reducing the potential for wildlife disturbance in these areas. No specific management actions for abandoned mines exist under Alternative A. Wind-energy development would affect bats similar to neotropical migrants. Overall, Alternative A would limit adverse impacts to bats by protecting cave resources and conserving potential bat habitat.

Nongame (Reptiles and Amphibians)-Alternative A

Implementing and/or stipulating appropriate management guidelines in *Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern U.S. and Canada*, *PARC Technical Publication HMG-4* (Pilliod and Wind 2008), and similar future guidance for activities that may impact amphibian/reptile habitat will benefit amphibians and reptiles by preventing, minimizing, or mitigating adverse impacts to these species. Retaining riparian vegetation when removing sediment from reservoirs would also benefit amphibian and reptile species such as aquatic turtles and amphibians in these areas by preserving their habitat. Biological resource management actions in other habitats also would affect reptiles and amphibians. Snakes occur in a variety of habitat types, while lizards typically occur in the drier habitats, particularly those with rock outcrops and cliffs. Impacts of management actions to these habitat types are discussed throughout this section.

Alternative B

Surface Disturbance-Alternative B

Alternative B would result in approximately 73,919 acres of short-term surface disturbance that may degrade wildlife habitat and 10,882 acres of long-term surface disturbance that may result in habitat loss (Table 4-1). Minerals development, fire and fuels management, and silviculture treatments are the largest sources of short-term disturbance, with minerals development being the largest source of long-term disturbance. Alternative B requires that all surface-disturbing activities are analyzed by mapping soils to a series level, collecting soils samples for analysis, and evaluating erosion conditions. This alternative also requires reclamation plans before disturbance, topsoil salvage, and establishing 50 percent of pre-disturbance vegetative cover within three growing seasons and 80 percent pre-disturbance cover within 5 years of initial seeding. These management actions would result in the greatest probability of successful reclamation, compared to the other alternatives, so that disturbed areas can return to suitable wildlife habitat in the long term. Alternative B requires the stabilization of all heavily eroded or washed out roads, and closes and reclaims these routes if alternative roads and trails are available. Overall, the projected surface disturbance and associated reclamation practices under Alternative B would result in the least short- and long-term adverse impacts to wildlife compared to the other alternatives.

Resource Uses-Alternative B

Minerals development would be the greatest contributor to habitat loss and fragmentation. Alternative B has the fewest acres available for locatable mineral entry, compared to the other alternatives, and is projected to result in approximately 5,000 acres of long-term disturbance that would cause habitat loss (Appendix T). Alternative B also places the most constraints on oil and gas leasing for which 509 new federal wells are projected. Alternative B would result in the least adverse impact to wildlife from minerals development, relative to the other alternatives.

Impacts to wildlife habitat from lands and realty management actions would be similar to those described under Alternative A. Under Alternative B, there would be more emphasis on retaining and acquiring lands in the Absaroka Front and certain ACECs. All acquisitions would be from willing sellers, and while increased acres have been identified, there is no certainty of acquisitions. Under Alternative B, the identification of specific land tenure adjustment zones may increase beneficial impacts to wildlife by identifying specific zones where land can only be disposed of or acquired if the transaction increases resource values, including the protection of wildlife resources (Zones 1B and 1C). Alternative B includes the largest amount of land in zones identified for retention, acquisition, and special disposal that may benefit wildlife resources.

Under Alternative B, the BLM would manage more land as ROW exclusion areas (225,750 acres) compared to the other alternatives, including 109,839 acres of big game crucial winter range and 18,359 acres of big game parturition habitat (Table 4-9). The ROW exclusion areas identified under this alternative would reduce powerline occurrences and lower the risk of raptor electrocution. Alternative B would result in a greater consolidation of ROWs that would cause less habitat fragmentation. ROW management under Alternative B would result in the least adverse impacts to wildlife, relative to the other alternatives.

Under Alternative B, the BLM avoids locating wind-energy projects in big game crucial winter range. Alternative B provides the greatest Planning Area-wide guidance for the location of wind-energy project development resulting in the least adverse impact to wildlife, compared to the other alternatives.

CTTM designations would limit the potential for the proliferation of unauthorized trails and related habitat degradation and wildlife disturbance. Under Alternative B, the BLM closes the greatest area (136,474 acres) to motorized vehicle use and restricts motorized vehicle use to designated roads and trails in the greatest area (2,054,228 acres). These restrictions would result in the greatest protection of wildlife from human-caused disturbances and sustain habitat integrity and water quality by preventing vegetation loss or soil erosion and compaction. Overall, motorized vehicle use with restrictions under Alternative B would result in the least adverse impact to wildlife, relative to the other alternatives.

Under Alternative B, the BLM does not develop or upgrade recreation sites unless otherwise called for in an SRMA or RMZ. Alternative B would result in more surface disturbance from recreational site development than alternatives A and D, but less than Alternative C (Appendix T); the increase in human presence and impact to wildlife would be proportional.

Under Alternative B, the Planning Area is open to livestock grazing where it does not conflict with other resource management objectives. Crucial winter range for elk and bighorn sheep—to prevent forage competition and possible displacement (Scolvin et al. 1968; Coe et al. 2004; Stewart et al. 2002)—and greater sage-grouse Key Habitat Areas are closed to livestock grazing and pronghorn crucial winter range is closed to new domestic sheep grazing. The BLM apportions additional sustained yield forage for wildlife, which would have the greatest beneficial impact to wildlife, compared to the other alternatives, by reducing the potential for competition with livestock (Vavra 1992 and Scolvin et al. 1968).

Special Designations-Alternative B

A detailed description of the beneficial impacts to wildlife from special designations is included below. Special designations under Alternative B that would directly benefit wildlife species by conserving habitat include the Carter Mountain and Upper Owl Creek ACECs and their expansions, the Little Mountain ACEC expansion, and the Chapman Bench, Clarks Fork Canyon, Rattlesnake Mountain, and Sheep Mountain ACECs. Additionally, the Absaroka Front Management Area would be specifically managed to protect and enhance wildlife habitat under Alternative B. Managing WSR suitable waterway segments to protect their free-flowing characteristics and ORVs would result in similar beneficial impacts as those under Alternative A, but to a greater degree as Alternative B applies greater protective measures around these segments to protect riparian habitat.

Resources-Alternative B

Under Alternative B, the BLM utilizes wildland fire and other vegetation treatments to restore fire-adapted ecosystems and to reduce hazardous fuels. Alternative B would result in approximately 25,000 acres of prescribed fire and mechanical fuels treatment (Appendix T). These management actions would cause fewer short-term adverse impacts to wildlife through temporary habitat loss and disturbance than Alternative A, but fewer long-term benefits because more area would remain in FRCC 2 and 3, more susceptible to catastrophic fire, and ultimately less fire adapted habitat would be restored. Based on the amount of vegetation treatment, Alternative B would result in the least long-term beneficial impact to wildlife from fire and fuels management, as in certain habitats fire is documented to improve the palatability of wildlife forage and provide age class diversity to habitats (BLM 2007f).

Under Alternative B, the BLM prohibits clear cuts and perform forest management only where natural processes are unable to accomplish forest health goals. Roads not required for other existing uses are closed, which would reduce human presence and the risk of unplanned ignitions in forestlands in the short term, and augment habitat and reduce habitat fragmentation in the long term. Forest management practices under Alternative B would result in the least short-term adverse impact to wildlife from disturbance and displacement. Wildlife in spruce and subalpine fir stands would

experience mostly beneficial impacts from prohibiting commercial forest management to let natural processes determine forest structure, while species in aspen, Douglas-fir, and ponderosa pine stands would mostly experience adverse impacts due to the lack of fuels reduction and stand diversification. Closing timber access roads would benefit wildlife species in all types of forest.

Under Alternative B, the BLM manages toward achieving 75 percent of Historical Climax Plant Community and manages large, contiguous blocks of land by maintaining or enhancing important plant communities. The amount of invasive species spread would be proportional to the total amount of surface disturbance (Table 4-1) in areas where invasive species seeds or plants are present. Alternative B would treat far less acreage to remove or control the spread of invasive species. Alternative B allows the authorized officer to require livestock flushing for 72 hours, which would reduce the potential for invasive species spread to a greater extent than Alternative A. The lesser extent of vegetation treatments under Alternative B would result in less short-term adverse impact to wildlife than Alternative A from disturbance, but less long-term beneficial impacts by enhancing habitat conditions and controlling the spread of invasive species.

The BLM manages all riparian/wetland areas to meet DPC under Alternative B. This management would ensure to the greatest extent, compared to the other alternatives, that riparian/wetland habitats provide conditions suitable to meet the life history requirements of various wildlife species. Alternative B prohibits surface-disturbing activities within ¼ mile of water and riparian/wetland areas and applies an NSO restriction on wetland areas greater than 40 acres, limiting habitat loss and fragmentation in these areas and benefiting wildlife that depend on these areas the most, compared to the other alternatives.

Proactive Management-Alternative B

Proactive management actions under Alternative B include applying wildlife seasonal protections for surface-disturbing and disruptive activities related to the maintenance and operation of a developed project when the actions are determined to be detrimental, identifying and preserving traditional migration and travel corridors for big game and migratory birds, and managing vegetation in areas identified as habitat for special status species and big game crucial winter range and parturition habitat to the most beneficial DPC while considering the habitat needs of other species. Based on their emphasis on implementation for both habitat protection and enhancement, proactive management actions under Alternative B would result in the most beneficial impact to wildlife, compared to the other alternatives.

Big Game-Alternative B

Alternative B prohibits surface-disturbing activities and applies an NSO restriction in big game crucial winter range and parturition habitat. The BLM avoids locating wind projects in big game crucial winter range and parturition habitat as well. Alternative B closes the greatest area in big game crucial winter range and parturition habitat to locatable minerals and oil and gas development (Table 4-9). Overall, restrictions on surface-disturbing activities and motorized vehicle use under Alternative B would result in the least adverse impact to big game.

Alternative B places the most restrictions on motorized vehicle use and prohibits over-snow vehicle use in big game crucial winter range and elk parturition habitat, which would provide additional protection from human disturbance of wildlife compared to Alternative A. Under Alternative B, 53,822 acres and 55,583 acres of big game crucial winter range are managed as closed or seasonally restricted for motorized travel respectively, while 3,950 acres and 41,184 acres of big game parturition habitat are managed as such. Special designations would result in beneficial impacts to big game where they

overlap big game habitat and restrict resource uses that degrade big game habitat or may disturb big game (e.g., oil and gas development and motorized vehicle use).

Alternative B expands the Carter Mountain, Upper Owl Creek, and Little Mountain ACECs that contain important big game habitats, migration corridors, and bighorn sheep populations, and ACECs designated under Alternative B encompass more big game crucial winter habitat and parturition habitat than Alternative A (Table 4-9). In addition to restrictions that exist under Alternative A, the Carter Mountain and Little Mountain expansion is unavailable to oil and gas leasing and withdrawn from locatable mineral entry. The Chapman Bench, Rattlesnake Mountain, and Sheep Mountain ACECs are also designated under Alternative B, which all contain important big game habitat and restrict motorized vehicle use and/or minerals development. Designating all LWCs as Wild Lands and managing them to protect primitive recreation and outstanding opportunities for solitude, and the associated restrictions on resource uses and activities, would benefit big game, as 246,064 acres of crucial winter range and 37,900 acres of parturition habitat lie within these lands (Table 4-9).

Proactive management actions under Alternative B result in multiple, primarily beneficial impacts to big game by conserving habitat values from potential impacts due to oil and gas development, reducing competition from livestock, and minimizing human-caused wildlife disturbance. Alternative B prohibits surface-disturbing and disruptive activities in big game crucial winter range (1,313,731 acres) and closes the Absaroka Front Management Area to mineral leasing, geophysical exploration, and motorized vehicle use in certain areas. The BLM limits motorized vehicle use to designated roads and trails with seasonal closures in big game crucial winter range and elk parturition habitat. Alternative B prohibits livestock grazing in elk parturition habitat during the birthing season (May 1 through June 30), domestic sheep grazing on pronghorn crucial winter range, and livestock grazing on crucial winter range for elk and bighorn sheep (Table 4-9) to increase forage availability, reduce forage competition and prevent possible displacement of these wildlife populations (Scolvin et al. 1968; Coe et al. 2004; Stewart et al. 2002). Furthermore, prohibiting water developments for livestock in elk crucial winter range unless no adverse impacts to wildlife can be demonstrated reduces the probability of concentrated livestock areas that may compact soil, damage vegetation, and increase the chance of invasive species spread. Conversely, closing elk habitat to livestock grazing entirely removes this resource use as a potential management tool to improve habitat through enhancing forage palatability and may result in adverse impacts to elk in these areas (Frisina 1992 and Anderson and Scherzinger 1975).

The BLM restores 100 acres of aspen stands per year over the life of the plan under Alternative B (for a total restoration similar to that of Alternative A), which would especially benefit moose and deer that use habitats with woody vegetation for forage. All of these actions protect habitat for big game and reduce habitat fragmentation and disruptive activities.

Due to the adverse impacts from projected surface disturbance and motorized vehicle use, and the beneficial impacts from proactive management actions and special designations under this alternative, Alternative B would result in the least adverse impact to big game, compared to the other alternatives.

Trophy Game-Alternative B

Black bears are most affected by management actions in forest and woodland habitats. Management actions under Alternative B that minimize adverse impacts to this species by preserving habitat values include forest management, when natural processes cannot achieve forest health goals, and prohibiting clear cuts.

As cougars are typically found in remote, rugged areas, the motorized vehicle use restrictions in WSAs under Alternative B would minimize potential adverse impacts to this species the most in these areas, compared to the other alternatives (USGS 2007). Under Alternative B, the BLM also designates all LWCs

as Wild Lands, manages them to protect wilderness characteristics, and restricts minerals development and motorized vehicle use in these areas. Alternative B would benefit cougars the most compared to the other alternatives by minimizing the potential of human disturbance in the greatest amount of remote area and providing the most beneficial impact to big game, including mule deer.

Furbearing Animals-Alternative B

Forest management actions under Alternative B maintain old growth forests and woodlands, which would benefit the American marten. Several furbearing mammal species (i.e., badger, beaver, mink, and muskrat) are most affected by management actions that impact riparian/wetland habitat or water availability. Impacts to these species are similar to those described below in the *Nongame (Neotropical Migrants)* section that use riparian/wetland habitat. Under Alternative B, the BLM manages all riparian/wetland areas to meet DPC, ensuring consideration of habitat requirements for wildlife. Alternative B would result in the smallest number of new oil and gas wells, and therefore may result in the least adverse impact to furbearing mammal species from altering water availability.

Predatory Animals-Alternative B

Alternative B actions that would benefit different vegetative types in the Planning Area are anticipated to benefit habitat generalists, such as predatory animals. Motorized vehicle restrictions and projected new road development under Alternative B are expected to cause the least adverse impacts to predatory animals such as the coyote and red fox.

Small Game-Alternative B

Alternative B actions benefiting forests, woodlands, riparian areas, and other habitat types would proportionally benefit the habitat generalist cottontail rabbit, and more habitat-specific species, such as the snowshoe hare and red squirrel. Preventing precommercial thinning except for fuels treatment would benefit snowshoe hare (USFS 2005b), as would regenerating aspen stands for wildlife values. Management actions to retain old growth forests in HUC Level 4 sub-basins would beneficially impact red squirrels by conserving their habitat.

Game Birds-Alternative B

Under Alternative B, management actions that enhance grassland and shrubland habitat, manage toward DPC in riparian/wetland areas, and control invasive species spread in shrub and grassland communities would provide the greatest benefit to greater sage-grouse, chukar, and gray partridge, compared to the other alternatives. Alternative B actions benefiting forests, woodlands, riparian areas, and other habitat types would proportionately benefit other game birds, such as the ruffed grouse, blue grouse, wild turkey, and pheasant that prefer these habitat types. Impacts to these habitats are discussed below under *Nongame (Neotropical Migrants)*. Late brood-rearing greater sage-grouse would benefit from alpine habitat conserved in the Carter Mountain and Owl Creek ACECs designated and expanded under Alternative B.

Waterfowl-Alternative B

Although there are no specific management actions for waterfowl, other biological resource management actions, particularly those pertaining to water and riparian/wetland habitats, would affect these species. Under Alternative B, the BLM would manage all riparian/wetland areas to meet DPC with consideration of habitat requirements for wildlife. Alternative B prohibits forage supplements within ½ mile of water or riparian/wetland areas, which would further minimize adverse impacts to these areas from livestock grazing, compared to Alternative A. Under Alternative B, the BLM would not use produced water to develop and enhance waterfowl habitats, resulting in less area of suitable habitat for

waterfowl and less beneficial impact from produced water than under the other alternatives. However, the risk of high water temperature or impaired water quality adversely affecting waterfowl would be less under Alternative B.

Nongame (Raptors)-Alternative B

Under Alternative B, the BLM applies a TLS to prohibit any activity or surface-disturbing activity within 1 mile of raptor nests from February 1 through July 31 or until young birds have fledged and a year-round CSU to protect the actual nest site from disturbance. The protective buffers around raptor nest sites under Alternative B (543,945 acres) are the largest and would minimize adverse impacts to raptors the most, compared to the other alternatives. Avoiding locating wind-energy projects in raptor concentration areas would minimize the potential for collision mortality and displacement.

Nongame (Neotropical Migrants)-Alternative B

Alternative B management actions pertaining to minerals development and motorized vehicle use restrictions; wind-energy development; forest management; management of sagebrush, grassland, and riparian/wetland habitats toward DPC; invasive species control; and fire management would result in the greatest beneficial impact to nongame neotropical migrants, compared to the other alternatives. Although the short-term impacts from prescribed fire and fuels treatments would be less under Alternative B, the increased risk of catastrophic fire that may completely destroy woodland and sagebrush habitat would be greater under this alternative.

Designated under Alternative B, the Chapman Bench, Rattlesnake Mountain, and Sheep Mountain ACECs conserve migratory bird nesting habitat.

Forest and Woodland Species – Alternative B closes the most area in forests and woodlands to locatable minerals and oil and gas development (Table 4-8). This alternative prohibits clear cuts and performs forest management only when natural processes cannot achieve forest health goals. BLM actions for silviculture treatments, forest products, and fuels reduction under this alternative would result in the least short-term disturbance but also pose the greatest risk for catastrophic fire. Planting conifer areas denuded by wildfire if they do not regenerate naturally within 20 years would result in a longer time before habitat is restored, compared to the other alternatives, but retaining old-growth forests and requiring with appropriate levels of snag retention during salvage would benefit wildlife. Overall, forest management practices under Alternative B would result in the least short-term impacts, but the long-term adverse impacts posed by the risk of wildfire are greatest under this alternative.

Mountain Shrub Species – Under Alternative B, the BLM manages mountain shrub communities toward achieving 75 percent or more of Historical Climax Plant Community—which would provide the greatest benefit to neotropical migrants, compared to the other alternatives—by enhancing habitat in these areas. Designating the Rattlesnake Mountain and Sheep Mountain ACECs would conserve mountain shrub habitat from disturbance.

Sagebrush and Desert Shrub Species – Species that utilize or depend on sagebrush habitats benefit from management actions for greater sage-grouse as discussed in Section 4.4.9 *Special Status Species - Wildlife*. Alternative B applies the largest buffers around greater sage-grouse leks and in nesting or early brood-rearing habitats to conserve sagebrush habitat. Under Alternative B, the BLM manages salt desert shrub and basin grassland/shrub communities toward 75 percent or more of Historical Climax Plant Community. Alternative B would result in the least surface disturbance that may result in habitat loss, especially in the 5- to 9-inch precipitation zone, and has the most stringent requirements for reclamation, which would result in the least impact to neotropical migrants that depend on sagebrush and desert shrub habitats.

Grassland Species – Actions in grassland habitats, such as surface-disturbing activities, reclamation, invasive species control, and livestock and wildlife grazing would affect these species. Under Alternative B, the BLM would manage grasslands toward achieving 75 percent or more of Historical Climax Plant Community, which would provide the greatest benefit, compared to the other alternatives, by enhancing habitat for neotropical migrants in these areas. However, closing crucial winter range for elk and bighorn sheep and greater sage-grouse Key Habitat Areas to livestock grazing would limit the use of livestock grazing as a tool where it may create vegetation heterogeneity that enhances habitat for grassland neotropical migrants (Derner et al. 2009). Refer to Section 4.4.2 *Vegetation - Grassland and Shrubland Communities* and Table 4-8 for a discussion of management actions and BLM-authorized activities that would impact grasslands and would similarly affect neotropical migrant habitat in these areas. Due to its projected long-term surface disturbance and reclamation requirements, Alternative B would result in the least habitat loss and degradation in grasslands compared to the other alternatives.

Riparian/Wetland Species – The restrictions on minerals development and other surface-disturbing activities in riparian/wetland areas and within WSR suitable waterway segments under Alternative B would result in similar beneficial impacts to those under Alternative A, but to a greater degree by further limiting degradation of riparian habitat. Refer to Section 4.4.3 *Vegetation – Riparian/Wetland Resources* and Table 4-8 for a description of management actions and BLM-authorized activities that would impact wetlands and riparian areas and would similarly affect neotropical migrant habitat in these areas. Based on these management practices, Alternative B would result in the greatest beneficial impacts to neotropical migrants that depend on riparian/wetland habitat.

Nongame (Mammals)-Alternative B

Although there are no specific management actions for nongame mammals, other biological resource management actions would affect these species. Nongame mammals are found in a variety of habitats and are affected by management actions in the preferred vegetation type of each species. Impacts to the various vegetation types are described above for nongame neotropical migrants and are expected to similarly impact nongame mammals.

Generally, the BLM places the greatest restrictions on surface-disturbing activities and motorized vehicle use to conserve cave resources under Alternative B. Activities are prohibited within ¼ mile of AMLs, which would reduce the opportunities for disturbances to bats in these areas. The BLM closes the Medicine Lodge and Trapper Creek WSAs to motorized vehicle use under Alternative B, minimizing human presence and the opportunities for wildlife disturbance in these areas. Little Mountain and Clarks Fork Canyon ACECs designated under this alternative would protect bat habitat. Alternative B places the greatest restrictions on the aerial applications of pesticides reducing potential adverse impacts to bat species. Wind-energy development would affect bats similar to neotropical migrants. Overall, Alternative B would result in the greatest beneficial impact to bats by protecting cave resources and conserving potential bat habitat.

Nongame (Reptiles and Amphibians)-Alternative B

The impacts to reptiles and amphibians under Alternative B would be similar to those under Alternative A, although to a lesser extent. Alternative B similarly applies management guidelines identified in *Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern U.S. and Canada*, *PARC Technical Publication HMG-4* (Pilliod and Wind 2008). The adverse impact to these animals would be correlated with surface disturbance (Appendix T) and beneficial impacts would result from habitat conservation and enhancement measures described throughout this section. Alternative B applies a larger buffer around riparian/wetland areas to prohibit surface-disturbing activities, which would

benefit amphibians and reptiles such as aquatic turtles in these habitats. Alternative B would result in less adverse impact to reptiles and amphibians than Alternative A.

Alternative C

Surface Disturbance-Alternative C

Alternative C would result in approximately 245,783 acres of short-term surface disturbance that may degrade wildlife habitat and 41,545 acres of long-term surface disturbance that may result in habitat loss and fragmentation (Table 4-1). Minerals development, fire and fuels management, and silviculture treatments are the largest sources of short-term disturbance, with minerals development also being the largest source of long-term disturbance. Alternative C requires that all surface-disturbing activities are analyzed by mapping, collecting, and evaluating soil on a case-by-case basis and that reclamation plans and topsoil salvage are performed on a case-by-case basis. The BLM requires 30 percent desired vegetative cover within three growing seasons, but does not specify a long-term vegetative cover requirement. These management actions would result in the least probability of successful reclamation, compared to the other alternatives, so that disturbed areas would be less likely to return to suitable habitat in the long term. Under this alternative, stabilization, but not closure or reclamation, is required for all heavily eroded or washed out roads. Overall, the projected surface disturbance and associated reclamation practices under Alternative C would result in the greatest short- and long-term adverse impact to wildlife.

Resource Uses-Alternative C

Minerals development would be the greatest contributor to habitat loss and fragmentation. Alternative C makes the most acres available for locatable mineral entry, compared to the other alternatives, projected to result in approximately 20,000 acres of long-term disturbance that may result in habitat loss and fragmentation (Appendix T). Alternative C also places the least constraints on oil and gas leasing for which 1,257 new federal wells are projected. Alternative C would result in the greatest adverse impacts to wildlife from minerals development, relative to the other alternatives.

Impacts to wildlife habitat from lands and realty management actions under Alternative C would be similar to those described under Alternative A, however, more area is identified for disposal (including disposal with restrictions and disposal for specific uses) than under the other alternatives. The impacts of identifying land tenure adjustment zones would result in impacts similar to those described for Alternative B. However, less land is included in Zones 1B and 1C, which require that land transactions improve the protection of wildlife resources, and disposal is allowed only in exchange for lands with higher resource values.

Under Alternative C, the BLM manages the least land as ROW exclusion areas (7,762 acres), including 1,007 acres in big game crucial winter range. Alternative C would result in the least consolidation of ROWs and the greatest habitat fragmentation. ROWs under Alternative C would result in the greatest adverse impact to wildlife, relative to the other alternatives.

Under Alternative C, the BLM allows wind-energy projects in big game crucial winter range and parturition habitat, raptor concentration areas, and greater sage-grouse nesting, brood-rearing, and winter concentration areas on a case-by-case basis. Alternative C provides more Planning Area-wide guidance for wind-energy project locations and turbines than Alternative A, but allows for their construction in wildlife habitat that may be sensitive to impacts. Wind-energy development under Alternative C would result in the second-greatest impact to wildlife, compared to the other alternatives.

CTTM designations would limit the potential for the proliferation of unauthorized trails and related habitat degradation and wildlife disturbance. Under Alternative C, the BLM closes the least area (10,636 acres) and opens the most area (14,873 acres) to motorized vehicle use, which would result in the greatest potential for human-caused disturbances, vegetation loss, and soil erosion and compaction. Permitting off-road motorized vehicle use for big game retrieval and access to dispersed campsites would result in impacts similar to those under Alternative A. Overall, motorized travel designations under Alternative C would result in less adverse impact to wildlife than Alternative A, due to the larger area with seasonal restrictions.

Under Alternative C, the BLM develops or upgrades recreation sites (i.e., camping sites, interpretive educational areas, day use areas) and the associated amenities and facilities if demand warrants. Alternative C would result in the greatest amount of surface disturbance from recreational site development and OHV play areas; the increase in human presence and impacts to wildlife would be proportional.

Under Alternative C, the BLM closes a similar amount of acreage to livestock grazing as under Alternative A, but manages livestock grazing to optimize commodity production while meeting rangeland health standards. Alternative C allows the placement of forage supplements to maximize livestock use, regardless of habitat sensitivity to potential vegetation impacts. As cattle are more likely to concentrate around forage supplements (Bailey 2001), their placement may increase the impact of livestock grazing on vegetation and soil in these areas that may impact wildlife. The potential for adverse impacts to wildlife from livestock grazing would be greatest under Alternative C.

Special Designations-Alternative C

As only two ACECs are designated under Alternative C (neither of which is proposed to protect wildlife values), this alternative would result in the smallest beneficial impact to wildlife habitat from special designations (Table 4-9). Alternative C does not recommend WSR eligible waterway segments as suitable for inclusion in the NWSRS and, therefore, would not protect riparian habitat in these areas to benefit wildlife as under alternatives A and B. Alternative C also places the least restrictions on motorized vehicle use in WSAs, which would result in the greatest potential for human disturbance of wildlife in these remote areas.

Resources-Alternative C

Under Alternative C, the BLM utilizes wildland fire and other vegetation treatments to restore fire-adapted ecosystems, to enhance forage for commodity production, and to reduce hazardous fuels. Alternative C would result in approximately 140,000 acres of surface disturbance from prescribed fire and mechanical fuels treatment (Appendix T). These management actions would cause the greatest short-term adverse impact to wildlife through temporary habitat loss, fragmentation, and disturbance, compared to the other alternatives, but would potentially result in the greatest long-term benefit from preventing catastrophic fire and restoring fire adapted habitat. Alternative C would potentially result in the greatest long-term beneficial impact to wildlife from fire and fuels management if management practices consider wildlife habitat needs.

Under Alternative C, the BLM allows forest management in areas classified as commercial forestland without specific regard for wildlife habitat values and allows clear cuts up to 100 acres, which is a larger area than allowed under Alternative A. Not retaining appropriate numbers of snags in salvage operations would adversely impact amphibians, reptiles, birds, and other small animals that depend on snags and downed wood for habitat. Forest management under Alternative C would result in the potential for altered forest structure that does not mimic natural conditions, which would adversely

impact wildlife. The BLM allows spur roads to remain open to meet other resource objectives or for new recreational purposes, which would result in short-term adverse impacts from increased human presence and the risk of unplanned ignitions in forestlands, and long-term adverse impacts from habitat loss and fragmentation. Forest management practices under Alternative C would result in the greatest short-term impact to wildlife from disturbance, displacement, and habitat loss. Alternative C may also result in the greatest long-term beneficial impact to species in aspen, Douglas-fir, and ponderosa pine stands by reducing hazardous fuels, if short-term impacts do not result in permanent habitat loss or displacement and forest structure is not substantially altered from natural conditions.

Under Alternative C, the BLM manages toward achieving the *Wyoming Standards for Healthy Rangelands* (Appendix N) and performs habitat enhancement vegetation treatments in sagebrush communities as opportunities and funding allow. The amount of invasive species spread, where invasive seeds or plants are present, would be proportional with the total amount of surface disturbance (Appendix T), and limited by vegetation treatments to remove or control invasive species spread on 4,000 acres. The BLM does not require livestock flushing under Alternative C, which increases the likelihood of invasive species spread that would degrade wildlife habitat, especially in grasslands and shrublands. The greater projected vegetation treatments and prescribed fire under Alternative C would result in the greatest short-term impact to wildlife. Despite treatment measures, surface disturbance and the associated establishment of invasive species would degrade the most habitat and result in the greatest adverse impact to wildlife under Alternative C due to the projected surface disturbance. Long-term benefits to wildlife would be realized only if vegetation management practices consider wildlife habitat needs along with other resource objectives.

The BLM manages all riparian/wetland areas to meet PFC under Alternative C without considerations for wildlife life history requirements. Alternative C allows surface-disturbing activities in flood plains or riparian/wetland areas on a case-by-case basis, which would potentially result in the greatest adverse impact to wildlife species in these areas from habitat degradation or loss.

Proactive Management-Alternative C

Proactive management measures that would result in beneficial impacts to wildlife are described in detail below. Proactive management actions under Alternative C include identifying and developing management for traditional migration and travel corridors for big game and migratory birds and managing vegetation in areas identified as habitat for special status species, crucial winter range, or parturition habitat for big game to the DPC that benefits all grazing/browsing animals. Proactive management actions under Alternative C would result in the fewest beneficial impacts to wildlife, compared to the other alternatives.

Big Game-Alternative C

Alternative C exempts Oil and Gas Management Areas (568,168 acres) and ROW corridors (133,284 acres) from discretionary wildlife seasonal stipulations. The BLM allows wind-energy development in big game crucial winter range and parturition habitat on a case-by-case basis. Alternative C would result in the greatest acres of surface disturbance due to minerals development and new road construction, which would result in proportional adverse impacts to big game, relative to the other alternatives. Alternative C closes motorized vehicle use on the smallest acreage of big game crucial winter range (8,068 acres) and seasonally restricts travel on the largest area (55,649 acres). This alternative closes a larger area of big game parturition habitat to motorized vehicle use than Alternative A and seasonally restricts the largest area (1,430 acres and 41,875 acres, respectively) of any alternative. The limited restrictions on surface-disturbing activities would result in the greatest adverse impact to big game, compared to the other alternatives, but the seasonal restrictions on motorized vehicle use under

Alternative C would limit adverse impacts to big game more than under Alternative A. The areas closed to livestock grazing under Alternative C are similar to those under Alternative A. Special designations under Alternative C would protect the least amount of big game crucial winter range and parturition habitat from surface-disturbing activities (Table 4-9).

Proactive management actions under Alternative C result in the fewest beneficial impacts to big game by providing less habitat protection to potential impacts from oil and gas development and competition from livestock due to prioritizing livestock forage allocation over wildlife. The BLM limits motorized vehicle use to designated roads and trails with seasonal closures in the Absaroka Front Management Area to minimize big game disturbance; however, big game crucial winter range and parturition habitat is afforded the least protection from surface-disturbing activities and potential disturbance under Alternative C (Table 4-9). Proactive management actions would result in the fewest beneficial impacts to big game under this alternative.

Due to the adverse impacts from projected surface disturbance and motorized vehicle use, and fewer beneficial impacts from proactive management actions and special designations under this alternative, Alternative C would result in the greatest adverse impact to big game, compared to the other alternatives.

Trophy Game-Alternative C

Black bears are most affected by management actions in forest and woodland habitats. Forest management practices under Alternative C result in the greatest short-term adverse impact to black bears from disturbance and displacement, but may result in the greatest long-term benefit, if displacement is not permanent, by improving stand diversity and preventing catastrophic wildfires.

Alternative C places fewer restrictions on motorized vehicle use in WSAs than alternatives A or B, which would result in the greatest potential for human-caused disturbance of cougars in these areas. Management actions affecting big game would have similar impacts on cougars.

Furbearing Animals-Alternative C

The BLM manages forestland under Alternative C for more forest production, resulting in a greater amount of activity that would disturb and displace wildlife. However, old growth forest areas are retained at appropriate locations and distribution levels, which would benefit the American marten in these areas.

Under Alternative C, the BLM manages all riparian/wetland areas to meet PFC without consideration of habitat requirements for wildlife. Alternative C would result in the most new oil and gas wells, and therefore may result in the greatest adverse impact to furbearing mammal species by contributing to the depletion of these rivers. Habitat degradation and loss would be greatest in riparian/wetland areas under Alternative C, and therefore would result in the greatest adverse impact to furbearing animals in these areas.

Predatory Animals-Alternative C

Alternative C actions that would impact different vegetative types in the Planning Area are anticipated to impact habitat generalists, such as predatory animals. Motorized vehicle use restrictions and new road development under Alternative C are expected to cause the greatest adverse impacts to predatory animals such as the coyote and red fox (USGS 2007).

Small Game-Alternative C

Alternative C actions affecting forests, woodlands, riparian areas, and other habitat types would have proportionate impacts on generalists like cottontail rabbits, as well as more habitat-specific species, such as the snowshoe hare, red squirrel, and flying squirrel. Precommercial thinning practices under Alternative C would result in similar adverse impacts to snowshoe hare, yet to a greater extent, than under Alternative A. Alternative C would result in no beneficial impacts from regenerating aspen stands, as is so under alternatives A and B.

Game Birds-Alternative C

Alternative C would result in the greatest potential habitat loss and spread of invasive species in shrubland and grassland communities due to surface disturbance and the greatest potential habitat loss and degradation of riparian/wetland areas due to surface disturbance and concentrated livestock grazing. Alternative C actions affecting forests, woodlands, riparian areas, and other habitat types would have proportionate impacts on other game birds, such as the ruffed grouse, blue grouse, wild turkey, and pheasant that prefer these habitat types. Impacts to these habitats are discussed below under *Nongame (Neotropical Migrants)*. Alternative C would result in the greatest adverse impact to game birds. Although using produced water to enhance wildlife habitat may beneficially impact some game bird species, Alternative C would result in the greatest adverse impact to game birds from habitat loss in shrubland and grassland communities and potential habitat degradation in riparian/wetland areas.

Waterfowl-Alternative C

Although there are no specific management actions for waterfowl, other biological resource management actions, particularly those pertaining to water and riparian/wetland habitats, would affect these species. Under Alternative C, the BLM would manage all riparian/wetland areas to meet PFC without consideration of wildlife life history requirements. Alternative C would result in a greater impact from concentrated livestock grazing than the other alternatives, because the BLM would place forage supplements to maximize usage without regard for sensitive habitat. Similar to Alternative A, Alternative C uses produced water to develop and enhance waterfowl habitats in accordance with federal, state, and local laws and regulations, which would have beneficial impacts to waterfowl.

Nongame (Raptors)-Alternative C

Under Alternative C, the BLM applies a TLS to avoid disruptive or surface-disturbing activity within ¼ mile of active raptor nests during specific species nesting periods, or until young birds have fledged. The protective buffers around raptor nest sites under Alternative C (53,336 acres) are the smallest and do not prohibit disruptive activities, which would result in the greatest potential adverse impacts to raptors compared to the other alternatives.

Allowing wind-energy projects in raptor concentration areas on a case-by-case basis would result in greater potential adverse impacts from displacement and collisions than alternatives B and D, but less than Alternative A.

Nongame (Neotropical Migrants)-Alternative C

Alternative C actions pertaining to minerals development and motorized vehicle use restrictions; wind-energy development; forest management; management of sagebrush, grassland, and riparian/wetland habitats; invasive species control; and fire management would result in the greatest impact to nongame neotropical migrants. Alternative C would result in the greatest short-term adverse impacts to these

species from prescribed fire and fuels treatments; however, the risk of catastrophic fire would be smallest under this alternative.

Alternative C does not designate any ACECs specially designed to protect wildlife values, such as migratory bird nesting habitat.

Forest and Woodland Species – Alternative C closes the least area in forests and woodlands to locatable minerals and oil and gas development, allows for the most disturbance in forests and woodlands from silviculture and fuels treatments, and permits the largest clear cuts. Under this alternative, the BLM restores forests denuded by wildfire in the shortest time period and retains old-growth forests, but not snags used by neotropical migrants for nest sites. Refer to Section 4.4.1 *Vegetation - Forests, Woodlands, and Forest Products* and Table 4-8 for a description of management actions and BLM-authorized activities that would impact forests or woodlands and would similarly affect neotropical migrant habitat in these areas. Overall, forest management practices under Alternative C would result in the greatest short-term impacts from habitat loss, disturbance, and displacement, but the long-term adverse impacts posed by the risk of wildfire are reduced under this alternative.

Mountain Shrub Species – Under Alternative C, the BLM manages mountain shrub communities toward achieving the *Wyoming Standards for Healthy Rangelands* (Appendix N), which would result in less habitat enhancement, compared to the other alternatives, to benefit neotropical migrants in these areas.

Sagebrush and Desert Shrub Species – Species that utilize or depend on sagebrush habitats benefit from management actions for greater sage-grouse as discussed in Section 4.4.9 *Special Status Species - Wildlife*. Alternative C applies the smallest buffers around greater sage-grouse leks and in nesting or early brood-rearing habitats. Under this alternative, the BLM manages salt desert shrub and basin grassland/shrub communities toward achieving the *Wyoming Standards for Healthy Rangelands*, which would result in less habitat enhancement, compared to the other alternatives, to benefit neotropical migrants in these areas. Alternative C would result in the most surface disturbance that may result in habitat loss, especially in the 5- to 9-inch precipitation zone, and has the least stringent requirements for reclamation. The associated loss of habitat and potential spread of invasive species would result in the greatest adverse impact to neotropical migrants that depend on sagebrush and desert shrub communities.

Grassland Species – Actions such as surface-disturbing activities, reclamation, invasive species control, and livestock and wildlife grazing in grassland habitats would affect these species. Under Alternative C, the BLM would manage foothills-mountain grassland/shrub and basin grassland/shrub communities to achieve *Wyoming Standards for Healthy Rangelands*, which would result in the fewest beneficial impacts to neotropical migrants from habitat enhancement in grassland communities. Focusing livestock grazing practices on commodity production would not likely create heterogeneous vegetative cover to enhance habitat for grassland neotropical migrants (Derner et al. 2009). Due to its projected long-term surface disturbance and reclamation requirements, Alternative C would result in the most habitat loss and degradation in grasslands compared to the other alternatives.

Riparian/Wetland Species – Under Alternative C, the BLM allows surface-disturbing activities in flood plains and riparian/wetland areas as well as the placement of forage supplements to maximize usage, without regard for habitat degradation. Alternative C does not recommend WSR eligible waterway segments as suitable for inclusion in the NWSRS and, therefore, would not result in additional beneficial impacts to riparian habitat for neotropical migrants. Based on these management practices and the potential water depletion due to oil and gas development, Alternative C would result in the fewest beneficial impacts to neotropical migrants that depend on riparian/wetland habitat.

Nongame (Mammals)-Alternative C

Although there are no specific management actions for nongame mammals, other biological resource management actions would affect these species. Nongame mammals are found in a variety of habitats and are affected by management actions in the preferred vegetation type of each species. Impacts to the various vegetation types are described above for nongame neotropical migrants and are expected to similarly impact nongame mammals.

Generally, the BLM places the least restrictions on surface-disturbing activities and motorized vehicle use to protect cave resources under Alternative C, and manages known caves for recreational opportunities. Activities are allowed in AMLs, creating opportunities for bat disturbance in these areas. The BLM allows motorized vehicle use on designated roads and trails in the Medicine Lodge and Trapper Creek WSAs under Alternative C, increasing human presence and the opportunities for wildlife disturbance in these areas. There are no ACECs designated under Alternative C that would conserve bat habitat. Restrictions on the aerial applications of pesticides would be more than alternatives A and D, but less than Alternative B, with correlated impacts to bat species. Wind-energy development would impact bats similar to neotropical migrants. Overall, Alternative C would result in the fewest beneficial impacts to bats by protecting cave resources and conserving potential bat habitat.

Nongame (Reptiles and Amphibians)-Alternative C

Based on implementation of management guidelines identified in *Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern U.S. and Canada, PARC Technical Publication HMG-4* (Pilliod and Wind 2008) on a case-by-case basis, the projected surface disturbance under Alternative C (Appendix T), and the allowance of surface-disturbing activities in riparian/wetland areas, Alternative C would result in the greatest adverse impact to reptiles and amphibians, compared to the other alternatives.

Alternative D

Surface Disturbance-Alternative D

Alternative D would result in similar short- and long-term surface disturbance as Alternative A, with proportional impacts to wildlife from all surface-disturbing activities in various resource programs. To minimize long-term habitat loss from surface disturbance, Alternative D imposes greater erosion prevention measures and reclamation requirements to disturbed areas than Alternative A. Alternative D requires reclamation plans, stipulations, or measures before surface disturbance, the reestablishment of healthy native or DPCs based on pre-disturbance species composition, and the use of temporary protective surface treatments, such as weed-free mulch, to facilitate reclamation. Overall, the projected surface disturbance under Alternative D is slightly more than under Alternative A, but the impacts to wildlife habitat would be mitigated to a greater extent.

Resource Uses-Alternative D

Alternative D closes less area to locatable minerals entry than Alternative A, but closes more area to oil and gas development in sensitive wildlife habitat such as big game crucial winter range and parturition habitat (Table 4-9). Therefore, minerals development under Alternative D would result in less adverse impact to wildlife than under alternatives A and C, but more than under Alternative B.

Impacts to wildlife habitat from lands and realty management actions under Alternative D would be similar to those under Alternative A; however, less area is identified for general disposal than alternatives A and C. The impacts of identifying land tenure adjustment zones would result in impacts

similar to those under Alternative C. Under Alternative D, more land is included in Zones 1B and 1C, which require that land transactions result in improved protection of wildlife resources, and disposal is allowed only in exchange for lands with higher resource values.

Under Alternative D, the BLM would manage more lands as ROW exclusion areas than under Alternative C, of which 9,961 acres are in big game crucial winter range (Table 4-9). ROWs under Alternative D would result in more adverse impacts than under Alternative B, but less than under alternatives A and C, based on the total acreage managed as ROW avoidance/mitigation or exclusion areas.

Renewable energy development under Alternative D would result in impacts similar to those under Alternative C, although to a lesser extent because the BLM avoids wind-energy projects in big game crucial winter range and parturition habitat and raptor concentration areas, and mitigates renewable energy development in greater sage-grouse Key Habitat Areas. Alternative D manages the most lands as renewable energy avoidance/mitigation areas and the second-most lands as renewable energy exclusions areas. Renewable energy development under Alternative D would result in more adverse impacts to wildlife habitat than under Alternative B, but less than under alternatives A and C.

Alternative D limits motorized vehicle use to designated roads and trails in more area than alternatives A and C and closes a similar amount of acreage as Alternative A to motorized vehicle use, protecting more wildlife habitat in the Planning Area than these alternatives. Permitting off-road big game retrieval would result in impacts similar to those under Alternative A, but to a lesser extent because off-road travel is limited to 300 feet from established roads. Overall, CTTM under Alternative D would cause more adverse impacts to wildlife than under Alternative B, but less than under alternatives A and C.

Impacts to wildlife from recreational site development and livestock grazing management would be similar to those under Alternative A.

Special Designations-Alternative D

Beneficial impacts to wildlife from special designations under Alternative D would be similar to those under Alternative A, but to a greater extent. Greater minerals development restrictions and ROW stipulations in the Carter Mountain, Five Springs Falls, Little Mountain, and Upper Owl Creek ACECs, and designating the Clarks Fork Canyon and Sheep Mountain ACECs would result in greater protective measures for wildlife habitat than Alternative A. Similar to Alternative C, Alternative D does not recommend WSR eligible waterway segments as suitable for inclusion in the NWSRS, resulting in no additional beneficial impacts to wildlife by preserving riparian habitat.

Resources-Alternative D

Overall, impacts to wildlife from fire and fuels management and forest, woodlands, and forest products management under Alternative D would be similar to those under Alternative A. Allowing larger areas to be clear cut would result in more habitat loss for wildlife species that prefer closed canopies; however, maintaining the structure and composition of old growth stands would benefit wildlife species that use this habitat type, such as the American marten.

Beneficial impacts to wildlife from grassland and shrubland community management under Alternative D would be similar to those under Alternative B, although to a lesser extent. Under Alternative D, the BLM would manage to achieve or make progress toward achieving 65 percent – instead of 75 percent under Alternative B – or more of Historical Climax Plant Community, resulting in less beneficial impact to wildlife habitat than under Alternative B. However, the BLM would treat more area for invasive species than Alternative B, providing greater long-term beneficial impact to wildlife by preventing the spread of invasive species that may degrade wildlife habitat. Livestock flushing practices would result in similar beneficial impacts as those under Alternative A.

The management of riparian/wetland vegetation under Alternative D would result in similar beneficial impacts as those under Alternative C, but to a greater extent. Managing streams with unique recreational or fishery values to obtain DFC may increase habitat values in these areas more than under Alternative C, but additional management would be necessary to ensure that habitat meets life history requirements for various wildlife species. Alternative D applies more stipulations to surface-disturbing activities near riparian/wetland areas than Alternative C, limiting adverse impacts from surface disturbance, and applies an NSO restriction on all wetlands greater than 20 acres, protecting the most wetland habitat compared to the other alternatives. Overall, beneficial impacts to riparian/wetland habitat for wildlife under Alternative D would be greater than under alternatives A and C, but less than under Alternative B.

Proactive Management-Alternative D

Proactive management measures that would benefit wildlife are described in detail below. Similar to Alternative A, the BLM modifies identified hazard fences in accordance with appropriate wildlife needs, prohibits domestic sheep grazing on pronghorn crucial winter range unless adverse impacts can be mitigated, and addresses traditional migration and travel corridors for big game wildlife species and migratory birds on a case-by-case basis under Alternative D. Similar to Alternative B, the BLM pursues land tenure adjustment authorities for the acquisition of, and interest in, lands for the improved management of important wildlife habitat and applies minerals development restrictions, although to a lesser extent, in the Absaroka Front Management Area. Similar to Alternative C, the BLM performs habitat enhancement vegetation treatments in sagebrush communities as opportunities and funding allow, uses produced water to develop and enhance wildlife habitat, and exempts Oil and Gas Management Areas from discretionary wildlife seasonal stipulations. Overall, proactive wildlife management actions under Alternative D would result in greater beneficial impacts to wildlife than under alternatives A and C, but less than under Alternative B.

Big Game-Alternative D

Alternative D exempts Oil and Gas Management Areas (134,214 acres) from discretionary wildlife seasonal stipulations similarly to Alternative C. However, Alternative D does not exempt ROW corridors from seasonal stipulations and avoids wind-energy projects in big game crucial winter range and parturition habitat and raptor concentration areas, resulting in less adverse impacts than Alternative C. Impacts from minerals development and new road construction under Alternative D would be less than those under Alternative A because of the additional restrictions applied to the Absaroka Front Management Area and the greater portion of big game parturition habitat administratively unavailable for oil and gas development (88 percent).

As a result of other resource concerns, 16,739 acres and 31,687 acres of big game crucial winter range are managed as closed or seasonally restricted for motorized travel, respectively, while 482 acres and 9,526 acres of big game parturition habitat are managed as such. Based on these acreages, impacts to big game from potential disturbance would be second-least under Alternative D. Overall, impacts to big game from motorized vehicle use would be less than under alternatives A and C, but more than under Alternative B.

Special designations under Alternative D would protect more big game crucial winter range and parturition habitat than under alternatives A and C, but less than under Alternative B. The BLM designates the Sheep Mountain ACEC and manages the Chapman Bench Management Area and 52,485 acres of Wild Lands with additional resource use restrictions that would benefit big game. Designating the Carter Mountain, Upper Owl Creek, and Little Mountain ACECs would result in similar beneficial impacts to those under Alternative A.

Proactive management actions under Alternative D would result in similar beneficial impacts to big game as under Alternative A, but to a greater extent. The BLM would apply various restrictions and stipulations on minerals development in the Absaroka Front Management Area (130,895 acres) that would benefit big game more than alternatives A and C. Avoiding livestock grazing in elk parturition habitat unless adverse impacts can be avoided or mitigated would limit potential adverse impacts to elk, while allowing for the use of livestock grazing as a management tool that can improve forage palatability for elk (Frisina 1992 and Anderson and Scherzinger 1975). The BLM avoids wind-energy projects in big game crucial winter range and parturition habitat under Alternative D as well, minimizing the potential for disturbance and displacement. Allowing the temporary closures of designated roads in big game crucial winter range and parturition habitat would limit adverse impacts to big game due to disturbance from motorized travel.

Trophy Game-Alternative D

Adverse impacts to black bears under Alternative D would be similar to those under Alternative A, but to a greater extent as clear cuts are allowed up to 100 acres. Alternative D places more restrictions on motorized vehicle use in WSAs than alternatives A and C, but less than Alternative B, resulting in proportional adverse impacts to cougars from potential disturbance. Alternative D also designates 52,485 acres of LWCs as Wild Lands, resulting in similar beneficial impacts to trophy game as Alternative B, but to a lesser extent. Based on big game management actions, the beneficial impact to cougars under Alternative D would be less than under Alternative B, but greater than under alternatives A and C.

Furbearing Animals-Alternative D

Based on forest management actions, beneficial impacts to furbearing animals under Alternative D would be similar to those under Alternative A, but to a greater extent. Based on projected surface disturbance, reclamation and restoration practices, and vegetation management, habitat generalists such as the badger, bobcat, and weasel would be adversely impacted under Alternative D more than under Alternative B, but less than under alternatives A and C. Management actions in old growth stands under Alternative D would benefit the American marten similarly to Alternative B, but restoring aspen stands only when opportunities and funding allow would result in less beneficial impact than alternatives A and B for the American marten and other furbearing mammals in this habitat. Furbearing species most affected by management actions that impact riparian/wetland habitat or water availability (badger, beaver, mink, and muskrat) would be beneficially affected less than under Alternative B, but more than under alternatives A and C.

Predatory Animals-Alternative D

Alternative D actions that would impact different vegetative types in the Planning Area are anticipated to impact habitat generalists such as predatory animals. Motorized vehicle use restrictions and new road development under Alternative D are expected to cause less adverse impacts to predatory animals, such as the coyote and red fox, than under alternatives A and C, but more than under Alternative B.

Small Game-Alternative D

Alternative D actions affecting forests, woodlands, riparian areas, and other habitat types would have proportionate impacts on the habitat generalists like cottontail rabbits, as well as more habitat-specific species, such as the snowshoe hare, red squirrel, and flying squirrel. Precommercial thinning practices under Alternative D would result in similar adverse impacts to snowshoe hare as under Alternative C, with the potential for limited beneficial impacts to this species from aspen restoration, if opportunities and funding allow.

Game Birds-Alternative D

Alternative D would result in less habitat loss and less potential for invasive species spread in shrubland and grassland communities than alternatives A and C (Table 4-8), with correlated impacts to game birds. Alternative D actions affecting forests, woodlands, riparian areas, and other habitat types would have proportionate impacts on other game birds, such as the ruffed grouse, blue grouse, wild turkey, and pheasant that prefer these habitat types. Impacts to these habitats are discussed below under *Nongame (Neotropical Migrants)*. Using produced water to develop and enhance wildlife habitat may beneficially impact some game bird species if the created habitat is suitable.

Waterfowl-Alternative D

Although there are no specific management actions for waterfowl, other biological resource management actions, particularly those pertaining to water and riparian/wetland habitats, would affect these species. Riparian/wetland management actions under Alternative D would result in less beneficial impacts to waterfowl than under alternatives A and B, but more than under Alternative C. Prohibiting forage supplements within ¼ mile of water, wetlands, or riparian areas and applying an NSO restriction to wetland areas larger than 20 acres would result in beneficial impacts similar to Alternative B, but to a greater extent. Special designations under Alternative D, including the Sheep Mountain ACEC, would restrict resource uses and activities, conserving migratory bird habitat. Using produced water to develop and enhance wildlife habitat may beneficially affect some game bird species if water quality is not impacted and the created habitat is suitable.

Nongame (Raptors)-Alternative D

Alternative D would result in more adverse impacts to raptors than Alternative B, but less than alternatives A and C. Although Alternative D seasonally protects less area (86,550 acres) around active raptor nests than Alternative A, it applies a year-round CSU stipulation to protect raptor nest sites and avoids wind-energy development in raptor concentration areas.

Nongame (Neotropical Migrants)-Alternative D

Alternative D management actions pertaining to minerals development and motorized vehicle use restrictions, wind-energy development, vegetation management, invasive species control, fire and fuels management, and special designations would result in more beneficial impacts to neotropical migrants than alternatives A and C, but less than Alternative B. The Chapman Bench Management Area and Sheep Mountain ACEC, designated under Alternative D, would conserve migratory bird nesting habitat.

Forest and Woodland Species – Management actions in forest and woodland habitat under Alternative D are similar to those under Alternative A and would, therefore, result in impacts to forest and woodland neotropical migrant species similar to Alternative A. Alternative D closes more area in forests and woodlands to minerals development than alternatives A and C, but less than Alternative B. Protecting old growth stands and leaving appropriate levels of snag retention to be used by neotropical migrants as nest sites would result in similar beneficial impacts to those under Alternative B. Alternative D allows larger clear-cuts than Alternative A, which would result in a greater beneficial impact for neotropical migrant species preferring open habitat but may reduce the reproductive success of some neotropical migrant species (Thompson III et al. 1993).

Mountain Shrub Species – Under Alternative D, managing mountain shrub communities toward achieving 65 percent or more of Historical Climax Plant Community would result in similar beneficial impacts, although to a lesser extent, than under Alternative B. Designating the Sheep Mountain ACEC

would restrict resource uses and activities that may disturb or displace neotropical migrants, benefitting mountain shrub species in this area.

Sagebrush and Desert Shrub Species – Species that utilize or depend on sagebrush habitats would benefit from management actions for greater sage-grouse as discussed in Section 4.4.9 *Special Status Species - Wildlife*. Alternative D applies more resource use and activity restrictions in greater sage-grouse habitat than alternatives A and C, with proportional limitations in adverse impacts to neotropical migrants in sagebrush habitat. Based on the restrictions on minerals development in sagebrush and desert shrub habitat (Table 4-8) and the reclamation requirements under Alternative D, this alternative is likely to result in fewer adverse impacts to neotropical migrants in these habitats than under alternatives A and C, but more than under Alternative B.

Grassland Species – Based on projected surface disturbance and management actions to restrict resource uses and activities in grassland habitat, vegetation management actions, reclamation practices, invasive species control, and livestock grazing management, Alternative D would result in less habitat loss and degradation in grasslands than alternatives A and C, but more than Alternative B, affecting neotropical migrants proportionately. Allowing livestock grazing in areas closed to grazing as a tool to maintain or improve resource conditions may beneficially impact neotropical migrants in these areas, if grazing practices create vegetation heterogeneity to benefit these species (Derner et al. 2009).

Riparian/Wetland Species – Vegetation management practices and the management of WSR eligible waterways under Alternative D would result in similar impacts to neotropical migrants as those under Alternative C, but neotropical migrants may benefit more from managing certain riparian areas to obtain DFC and prohibiting livestock forage supplements within riparian/wetland areas. Alternative D would also restrict surface-disturbing activities in more wetland areas. Overall, Alternative D would result in more adverse impacts to neotropical migrants in riparian/wetland habitat than Alternative B, but less than alternatives A and C.

Nongame (Mammals)-Alternative D

Although there are no specific management actions for nongame mammals, other biological resource management actions would affect these species. Nongame mammals are found in a variety of habitats and are affected by management actions in the preferred vegetation type of each species. Impacts to the various vegetation types are described above for nongame neotropical migrants and are expected to similarly impact nongame mammals. Special designations and restrictions around AMLs under Alternative D would result in similar beneficial impacts to bat species as Alternative B, although to a lesser extent. Adverse impacts from aerial pesticide application would be similar to Alternative A. Wind-energy development would affect bats similar to neotropical migrants.

Nongame (Reptiles and Amphibians)-Alternative D

Impacts to reptiles and amphibians under Alternative D would be similar to those under Alternative C, although to a lesser extent. Greater surface-disturbance restrictions in riparian/wetland areas than under Alternative C, avoiding reservoir work during amphibian mating and metamorphosis periods, and retaining riparian vegetation to benefit habitat values when cleaning or removing sediment from reservoirs would limit adverse impacts to reptiles and amphibians.

Special Status Species

4.4.7 Special Status Species – Plants

Adverse impacts are those that contribute to the decline in abundance or distribution of BLM special status plant species. Beneficial impacts to BLM special status plant species consist of activities that protect habitat or reduce the risk of harm to these species. An increase in BLM special status plant species numbers over time in response to an enhanced habitat or the increased viability of species is considered a beneficial impact.

For this analysis, direct impacts to BLM special status plant species are those actions resulting in damage to or loss of individual BLM special status plants, fragmentation of habitat, loss of habitat quality, loss of pollinators, and loss of soil seed banks. Direct impacts may result from surface-disturbing activities, trampling, herbivory, fire, and herbicide application. Indirect impacts to BLM special status plant species are those actions that aid or compromise the protection of these species. There may be indirect impacts to potential habitats for BLM special status plant species when actions change the habitats in a way that make them unsuitable for future colonization.

For this analysis, short-term impacts to BLM special status plant species include those activities that contribute to the decline in abundance or distribution of a species within 5 years of when the activity occurs. Long-term impacts to BLM special status plants take more than 5 years to manifest on the surface.

4.4.7.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Where resources overlap, management actions associated with protecting wildlife habitats and cultural resources directly benefit BLM special status plant species.
- Unless specifically designed to enhance BLM special status plant species habitat, surface-disturbing activities in BLM special status plant habitat would adversely affect BLM special status plant species.
- As more monitoring and survey data become available, it is possible that additional populations of existing BLM special status plants and unique plant communities might be found.
- The total amount of new surface disturbance allowed by an alternative is an index of potential impacts to BLM special status plants. Success of reclamation measures prescribed as a condition of development is unknown, and could either overestimate or underestimate the potential impact of surface disturbance on BLM special status plant populations.
- The existing provisions in place (e.g., presence/absence surveys performed before proposed actions) to protect BLM special status plant species populations are carried out and conditional monitoring is performed (e.g., grazing and surface disturbance reclamation) to ensure BLM special status plant species populations are not jeopardized.
- Management actions that preclude or restrict development, including those not specifically aimed at conserving BLM special status plant species, are assumed to benefit BLM special status plant species where populations overlap with management action boundaries.

- Because the densities and locations of BLM special status plant species in the Planning Area are not entirely known and because the locations of potential actions under the different alternatives also are not known, impact analyses are based on the amount of vegetation and soil disturbed, the threats identified for BLM special status plant species in Chapter 3, and the level of restrictions placed on BLM actions that could adversely impact BLM special status plant species.
- Consultation with the USFWS and following conservation measures identified in the BA for all listed and sensitive species for the BLM *Final Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS* (BLM 2007a) are anticipated to mitigate most impacts to BLM special status plant species.
- Actions that reduce the threat of establishment or spread of invasive species directly benefit BLM special status plant species. IM 2006-073 (BLM 2006b) establishes policy and guidance for use of certified weed-free seed and mulch in restoration projects on public lands.

4.4.7.2 Summary of Impacts by Alternative

The principle adverse impacts to BLM special status plant species result from management that increases surface disturbance and habitat fragmentation; the principle beneficial impacts include management that increases restrictions in known or potential BLM special status plant species habitat. Based on the acreage of surface disturbance, the potential for habitat fragmentation, and proactive management actions and special designations to protect BLM special status plant species, alternatives with the least to most potential adverse impacts to BLM special status plant species are alternatives B, D, A, and C. Alternative B would result in the least surface disturbance and habitat fragmentation, followed by alternatives A, D, and C respectively. However, Alternative D contains management actions to minimize habitat fragmentation that alternatives A and C do not contain. Alternative B includes the most provisions to protect sensitive soils and riparian areas for the benefit of BLM special status plants, followed by alternatives D, A, and C respectively. Restrictions on motorized vehicle use, especially restricting motorized cross-country travel, would reduce adverse impacts to BLM special status plant species the most under Alternative B, followed by alternatives D, A, and C respectively.

4.4.7.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Various surface-disturbing activities, including mineral exploration and development and the associated roads, ROWs, and corridors, can directly affect habitats for BLM special status plant species. Recreational use, collection of plants, fire, as well as livestock, wild horse, and native ungulate grazing may remove or trample vegetation and disturb soil, resulting in adverse impacts to BLM special status plant species. Surface-disturbing activities also can indirectly affect BLM special status plant species by contributing to soil erosion and transporting invasive species into BLM special status plant species habitats. The spread of invasive species could adversely affect BLM special status plants due to the limited size and distribution of these sensitive plants. Surface disturbance also can result in habitat fragmentation, which can isolate populations of BLM special status plant species. Populations of BLM special status plant species typically have a patchy distribution across the landscape, and eliminating one or more populations can prevent gene flow among populations if residual populations are too far apart for sufficient cross-pollination. Habitat fragmentation would be a long-term impact to BLM special status plant species. Implementing the *Wyoming Mitigation Guidelines for Surface-disturbing and*

Disruptive Activities (Appendix H) and the *Wyoming BLM Reclamation Policy* (BLM 2009l) minimizes adverse impacts from surface disturbance.

Several BLM special status plant species (e.g., Shoshonea, Absaroka beardstongue, Evert's waferparsnip, Wyoming tansymustard, limber pine, whitebark pine) occur in inaccessible areas, rugged terrain, or on unstable slopes in the Planning Area. As a result, there are fewer threats to these species and the anticipated adverse impacts from surface-disturbing activities are minimal. Management actions that restrict surface disturbance on unstable slopes would result in beneficial impacts to these species. For BLM special status plant species in riparian/wetland areas (e.g., Ute ladies'-tresses, persistent sepal yellowcress), management actions that limit activity in these areas are anticipated to benefit these species by reducing direct impacts from trampling, mining, and recreational activities. Meeting PFC across all alternatives improves habitat for Ute ladies'-tresses and persistent sepal yellowcress.

Livestock grazing may result in both adverse and beneficial impacts to BLM special status plants depending on grazing intensity, timing/season of grazing, range conditions, and precipitation regimes. Livestock grazing may maintain or create habitat for BLM special status plant species by reducing competition. However, livestock grazing may result in direct mortality through trampling, herbivory, and general site degradation (e.g., soil compaction, erosion). Livestock grazing in areas of Ute ladies'-tresses could benefit this BLM special status plant species as long as grazing occurs outside the flowering period. Adverse impacts to Williams' spring-parsley and Hyattville milkvetch from livestock grazing are not anticipated, as cattle and sheep are not known to graze on these plants. Under all alternatives, adherence to *Wyoming Standards for Healthy Rangelands* (Appendix N) would help to limit impacts to BLM special status plant species. Potential adverse impacts from wild horse grazing would be limited to HMAs and would be similar under all alternatives as the initial appropriate management level for the HMAs would remain the same.

Travel and transportation management may adversely affect BLM special status plant species if motorized travel is allowed in areas with these species. Motorized vehicle use disturbs soil and removes vegetation resulting in adverse impacts to BLM special status species plant habitat. The generation of dust from motorized vehicle travel on roads next to BLM special status plant species could affect plant development, growth, reproduction and overall population survival if there are only a few individual plants in the area. Invasive species are more likely to spread along trails and roads and may out compete BLM special status plant species.

Management in special designations (e.g., ACECs) ultimately protects special status plant species by avoiding or prohibiting surface-disturbing activities in these areas. These designations may increase the interest, popularity, and use of these areas, resulting in increased potential for disturbance and removal of BLM special status plant species and the spread of invasive species.

Some management actions generally benefit all BLM special status plant species. For example, management to control invasive species may benefit BLM special status plants by reducing competition for available habitat. Management actions that protect erosive soils, riparian areas, and steep slopes are beneficial to most BLM special status plant species. Beneficial impacts are anticipated for BLM special status plant species where protection of visual and cultural resources, fish and wildlife habitat, and vegetation overlap with suitable habitat for these species. Requirements for surveys of BLM special status plant species reduces disturbance to these species from construction of utility systems and other facilities. In addition, these surveys may identify new locations of BLM special status plant species, thereby increasing knowledge of these species. The BLM would also consult with stakeholders in the permitting process to design projects in a manner that would minimize or avoid potential adverse effects to BLM special status plant species.

Alternative A

Surface Disturbance

Surface-disturbing activities such as energy and mineral development, road construction, and other mechanized disturbance could cause adverse impacts to known BLM special status species plant populations and potential habitats, and undocumented populations. These activities fragment habitats, potentially isolating populations of BLM special status plants. Reclamation mitigates short-term impacts of surface disturbance by minimizing soil erosion and the establishment of invasive species. However, even with reclamation, surface-disturbing activities can have long-term adverse impacts to BLM special status plants through changes in the plant community structure or encroachment of invasive species. Under Alternative A, BLM actions are projected to result in 136,415 acres of short-term surface disturbance on BLM-administered land and 15,710 acres in the long term over the life of the plan (Table 4-1). Maintenance of healthy soil conditions enhances the viability, vigor, and abundance of BLM special status plant species.

Resource Uses

Assuming exploration and development of minerals will continue in the Planning Area and potentially increase for some minerals, the potential for adverse impacts to special status plants will increase proportionately. Alternative A has the second-most acreage open to oil and gas leasing subject to the terms and conditions of the standard lease form only and the most acreage open with major constraints. Required pre-disturbance surveys, mitigation, and reclamation will minimize impacts from mineral development.

The spread of invasive species may adversely affect special status plant species, which are limited in size and distribution. However, due to management of invasive species, the BLM anticipates that adverse impacts from invasive species would be minimal, with cheatgrass being the species with the most potential to adversely impact special status plant species. Management of invasive species could directly benefit special status plants by eliminating direct competition and maintaining habitat health and diversity. In particular, eradication of invasive species in riparian areas (e.g., Tamarisk, Russian olive) benefits Ute ladies'-tresses and persistent sepal yellowcress. Under Alternative A, aerial application of pesticides is allowed on a case-by-case basis and livestock flushing is required on a case-by-case basis. Livestock flushing minimizes the transport of invasive species in fecal material onto or within BLM-administered lands.

The development of ROWs may result in habitat fragmentation and degradation resulting in adverse impacts to special status plants. The development and use of linear ROWs can also lead to an increase in the spread of invasive species resulting in adverse impacts to special status plants. ROWs concentrated in a corridor tend to localize or confine disturbance to a smaller area and reduce disturbance in areas identified as sensitive. Under Alternative A the BLM manages 61,416 acres as ROW exclusion areas, limiting adverse impacts.

Motorized vehicle use may adversely affect habitat for special status plants. Alternative A has the greatest acreage limited to existing roads and trails and the second least acreage closed to motorized vehicle use in the Planning Area. Invasive species are more likely to spread to areas with roads and trails used by motorized vehicles. Permitting off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations would result in soil disturbance, vegetation removal, and transport of invasive species. Motorized vehicle use is a threat to Rocky Mountain twinpod, Hyattville milkvetch, and Dubois milkvetch (Mills and Fertig 2000b; Fertig 2001; and

Fertig 2000a), and is anticipated to indirectly and adversely impact known and unknown populations of special status plant species under Alternative A.

Under Alternative A, the Planning Area is open to livestock grazing, except in areas specifically closed including Bighorn River tracts, campgrounds, and exclosures. While trampling and herbivory from livestock grazing may result in direct adverse impacts to special status plant species, Alternative A manages livestock grazing to protect or enhance other resource values, minimizing adverse impacts. In addition, by instituting a ¼-mile buffer around riparian/wetland areas for placement of salt, mineral, or forage supplements, Alternative A minimizes adverse impacts to Ute ladies'-tresses and persistent sepal yellowcress.

Special Designations

Two existing ACECs that include special status species as their value of concern are Five Springs Falls and Upper Owl Creek, although other ACECs may also include BLM special status plant species. Protecting special status plants in these areas directly benefits the species known to occur there. Management of the Five Springs Falls ACEC and Upper Owl Creek ACEC includes NSO restrictions for leasable minerals, resulting in beneficial impacts to special status plants. While Upper Owl Creek ACEC is open to ROW authorizations, a detailed activity plan must be developed and approved before any surface-disturbing activity in the ACEC, which may minimize adverse impacts to special status plant species.

No WSRs are currently designated in the Planning Area; however, twenty waterways meet the WSR eligibility criteria. Management of these waterways to protect their ORVs and their free-flowing characteristics, results in beneficial impacts to Ute ladies'-tresses and persistent sepal yellowcress by minimizing disturbances to riparian/wetland habitat.

Resources

Soil compaction and erosion may result in indirect adverse and long-term impacts to special status plant species. Several special status plant species occur in areas with sparse vegetative cover, on steep slopes, and in rocky areas; therefore, management actions that limit activities in these areas and protect the integrity of the soils in the area, are anticipated to have beneficial impacts to these species. Alternative A does not require reclamation plans, although it reestablishes vegetation cover on disturbed soils within 5 years of initial seeding.

Changes in water management that reduce the periodicity of flooding may impact Ute ladies'-tresses and persistent sepal yellowcress (Heidel 2007 and Handley and Heidel 2008). Alternative A encourages the maintenance of natural flow regimes for streams supporting fisheries, but does not require it, which could adversely impact Ute ladies'-tresses and persistent sepal yellowcress.

Wildland fires may affect special status plant species by temporarily removing vegetation, changing plant community composition, and inhibiting plant succession. If special status plants depend on a specific seral stage or associative plants, a wildland fire could upset the ecological balance that supports a sensitive plant's habitat or plant community. Wildland fire also may enhance habitat for special status plants and be a catalyst for their reestablishment and proliferation. Habitat degradation from invasion of Utah juniper due to fire suppression has been identified as a threat to Hyattville milkvetch (Fertig and Welp 2001). Alternative A utilizes wildland fires to restore fire-adapted ecosystems, which could benefit Hyattville milkvetch.

Alternative A manages all riparian/wetland areas to meet or make progress toward meeting PFC, but does not prioritize those not meeting PFC. Under Alternative A, the 500-foot buffer for surface-disturbing activities around riparian/wetland areas would reduce adverse impacts to special status plants in these areas. The buffer reduces the potential for direct removal of special status plants,

sedimentation, and the potential for invasive species establishment, which have indirect adverse impacts to special status plant species.

Where restrictions of surface-disturbing activities are implemented for fish and wildlife habitats, special status plant habitats could be improved and adverse impacts to these species minimized. Alternative A institutes a TLS in big game crucial winter range and a CSU stipulation for big game migration corridors and parturition areas, and narrow ridges. Alternative A manages habitat, on a case-by-case basis, for the appropriate DPC based on the presence of special status species, potentially benefitting BLM special status plants in the long term.

Proactive Management

Under Alternative A, proactive management actions implemented include reviewing actions, use authorizations, rangeland improvement projects, invasive species treatments, and fire suppression effects for potential impacts to BLM special status plant species before performing these tasks. For all these tasks, avoidance and mitigation measures are implemented on a case-by-case basis. These reviews are anticipated to benefit BLM special status plant species. Alternative A does not identify any buffer around BLM special status plant species for placement of forage supplements; however, mitigations to avoid BLM special status plant species are routinely applied at the site-specific activity level when appropriate.

Alternative B

Surface Disturbance

Under Alternative B, BLM actions are projected to result in 73,919 acres of short-term surface disturbance to BLM-administered land and 10,882 acres of long-term surface disturbance over the life of the plan, the least acreage of all alternatives (Table 4-1). In addition to causing less surface disturbance, Alternative B reduces the potential for habitat fragmentation by maintaining large, contiguous blocks of native plant communities. The restrictions on habitat fragmentation and fewer disturbed acres relative to Alternative A are anticipated to indirectly benefit BLM special status plant species by protecting potential habitats, minimizing the spread of invasive species, and minimizing soil erosion.

Resource Uses

Under Alternative B, approximately 2,296,279 acres are administratively unavailable to oil and gas leasing, approximately 14 times more acreage than under Alternative A, 15 times more acreage than under Alternative C, and eight times more acreage than under Alternative D. While required mitigation and reclamation under all alternatives minimizes adverse impacts from mineral development, Alternative B results in fewer adverse impacts to BLM special status plant species due to the greater acreage unavailable for oil and gas leasing. Alternative B has the least acreage open for oil and gas leasing subject to standard constraints, the least acreage available subject to moderate constraints, and the second greatest acreage subject to major constraints.

Invasive species spread would result in similar potential adverse impacts to those under Alternative A, but to a lesser extent. The BLM treats less acreage to eradicate or control the spread of invasive species under Alternative B; however, this alternative would cause less surface disturbance and the BLM employs greater measures to return disturbed areas to native vegetation communities, leaving less area vulnerable to invasive species establishment. Allowing the aerial application of pesticides within ½ mile of riparian/wetland areas to manage riparian weed species would beneficially impact the Ute ladies'-tresses and persistent sepal yellowcress. Overall, management of invasive species would have the least

adverse impact to BLM special status plant species under Alternative B, compared to the other alternatives.

Alternative B designates the greatest acreage (225,750 acres) as exclusion areas for ROWs and corridors resulting in the greatest beneficial impacts to BLM special status plants by minimizing habitat fragmentation and degradation.

Under Alternative B, adverse impacts to BLM special status plant species from motorized vehicle use are anticipated to be the least of all the alternatives because Alternative B has the greatest acreage closed to motorized vehicle use, the least acreage limited to existing roads and trails, and the greatest acreage limited to designated roads and trails. Prohibiting off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations would also reduce the impacts from this action described under Alternative B. The anticipated soil disturbance, vegetation removal, and transport of invasive species under Alternative B are expected to produce the least indirect and adverse impacts to unknown populations of BLM special status plant species compared to other alternatives.

Livestock grazing is more limited under Alternative B than under alternatives A, C, and D as approximately 253,626 acres of crucial winter range for elk and bighorn sheep and 1,231,242 acres of greater sage-grouse Key Habitat Areas are closed to livestock grazing. Closing more acres to livestock grazing would result in less potential adverse impact to BLM special status plant species from trampling and herbivory. Additionally, Alternative B prohibits forage supplements within ½ mile of BLM special status plant species populations to minimize adverse impacts from livestock grazing. Expanding the McCullough Peaks HMA boundary may increase the extent of adverse impacts from wild horse grazing, but maintaining the initial appropriate management level for wild horses would not change the intensity of impacts. Alternative B would result in greater beneficial impacts to Ute ladies'-tresses and persistent sepal yellowcress than alternatives A, C, and D because of the larger buffer around riparian/wetland areas with respect to placement of forage supplements. In addition, Alternative B places more emphasis on meeting the rangeland health standards and maximizing multiple use benefits. More effective monitoring, management, and implementation of some grazing systems may benefit BLM special status plant species under Alternative B.

Special Designations

In addition to carrying forward the Five Springs Falls and Upper Owl Creek ACECs that emphasize protection of BLM special status plant species, Alternative B expands the existing Upper Owl Creek, Carter Mountain, and Little Mountain ACECs, and proposes designating Clarks Fork Canyon, Rattlesnake Mountain, and Sheep Mountain ACECs, all of which support BLM special status plant populations. Other ACECs under Alternative B may include BLM special status plant species as well. Designating these additional ACECs minimizes adverse impacts to the BLM special status plant populations within the boundaries of the ACECs because managing these areas helps protect these populations. This alternative provides the greatest opportunity to maintain BLM special status plant habitats in special designations.

Alternative B manages 20 waterways as suitable for inclusion in the NWSRS, which includes approximately 26,761 acres in the Planning Area. This alternative prohibits surface-disturbing activities on BLM-administered lands in the WSR suitable waterways, withdraws the segments from appropriation under the mining laws, closes the areas to geophysical exploration, and manages the segments as ROW exclusion areas. This type of management protects the values of the segments more than under Alternative A. Alternatives C and D do not recommend any segments as suitable for inclusion in the

NWSRS; therefore, the anticipated beneficial impacts to BLM special status plant species under Alternative B are more than under alternatives A, C, and D.

Resources

Alternative B includes additional protective measures for soils compared to Alternative A. Reclamation plans are developed and approved before starting any surface-disturbing activities, areas are reclaimed based on pre-existing plant communities, and inventories and mapping of soils to determine erosion and degree of soil stability are completed. By understanding the soils better, the BLM can institute required BMPs that will be most effective in each area, thereby potentially reducing erosion, and minimizing adverse impacts to BLM special status plant species. The anticipated level of soil erosion and compaction are expected to be less under Alternative B than under alternatives A, C, and D.

While Alternative A may fence springs and reservoirs to meet resource objectives, Alternative B may also fence riparian/wetland areas as necessary, potentially increasing the beneficial impacts to BLM special status plant species in these habitats. In addition, Alternative B maintains natural flow regimes for streams supporting fisheries. This is important to Ute ladies'-tresses and persistent sepal yellowcress, which depend on periodic flooding events during their life-cycles. Alternative B (and alternatives A and D) has additional beneficial impacts to BLM special status plant species compared to Alternative C because it reduces sediment loading in streams by developing and implementing watershed improvement practices.

Under Alternative B, the BLM utilizes wildland fire and other vegetation treatments to restore fire-adapted ecosystems, which could result in the same or fewer beneficial impacts to Hyattville milkvetch than Alternative A because Alternative B relies mostly on natural processes, and less on active restoration. Wildland fire and other vegetation treatments could be used to reduce the invasion of Utah juniper into Hyattville milkvetch habitat.

Alternative B is anticipated to result in greater beneficial impacts to BLM special status plants in riparian/wetland habitats than Alternative A because Alternative B manages these habitats to achieve DPC, prioritizes those areas not meeting PFC, and increases the buffer prohibiting surface-disturbing activities around riparian/wetland habitats to ¼ mile. Through these management actions, the potential for direct removal of BLM special status plants, sedimentation, and spread of invasive plants is less than under Alternative A. In addition, Alternative B applies an NSO restriction to wetlands larger than 40 acres.

Alternative B provides more protections to big game crucial winter range and parturition areas by establishing the Absaroka Front Management Area and applying an NSO restriction to these ranges and areas elsewhere, and prohibiting surface disturbance within ½ mile of migration corridors. These restrictions result in beneficial impacts to BLM special status plants in these areas, by reducing removal and trampling of these species. Because the restrictions are NSO, the beneficial impacts are anticipated to be greater than under Alternative A.

Proactive Management

Alternative B includes the greatest amount of restrictions for the protection of special status plant species habitat and provides the greatest amount of protection to known populations of BLM special status plants compared to the other alternatives. Range improvement projects are not allowed within ½ mile of known BLM special status plant species, forage supplements are prohibited within ½ mile of BLM special status plants, aerial applications of pesticides are prohibited with 1 mile of BLM special status plants, and surveys are required in potential BLM special status plant habitats before approving any

project. The increased buffers and required surveys compared to Alternative A aid in habitat protection and potential expansion of BLM special status plant populations.

Alternative C

Surface Disturbance

Under Alternative C, BLM actions are projected to result in 245,783 acres of short-term surface disturbance on BLM-administered land and 41,545 acres of surface disturbance in the long term over the life of the plan, the greatest acreage of all alternatives (and more than double the acreage of Alternative A) (Table 4-1). Similar to Alternative A, Alternative C increases the potential for habitat fragmentation by not maintaining large, contiguous blocks of native plant communities. By having fewer restrictions on habitat fragmentation and disturbing more acres than alternatives A, B, and D, Alternative C is anticipated to indirectly benefit BLM special status plant species less than the other alternatives. The spread of invasive species and extent of soil erosion would be greatest under Alternative C.

Resource Uses

Alternative C has the greatest acreage open to oil and gas development subject to standard constraints, the second greatest acreage subject to moderate constraints, the second least acreage subject to major constraints, and the least acreage administratively unavailable to oil and gas development. While required mitigation and reclamation under all alternatives minimizes adverse impacts from mineral development, Alternative C could result in the greatest adverse impacts to BLM special status plant species due to implementing the least restrictions to these activities.

Under Alternative C, implementing a ½-mile buffer around BLM special status plant species prohibiting aerial herbicide application may result in less adverse impacts from invasive species management to Ute ladies'-tresses and persistent sepal yellowcress than under alternatives A and D (under which aerial application is permitted), but more than Alternative B (under which the BLM implements a 1-mile buffer). Alternative C allows exceptions to this buffer to manage riparian weed species, which could benefit Ute ladies'-tresses and persistent sepal yellowcress in the long term. Under Alternative C, impacts from transport of invasive species by livestock are anticipated to be greater than any other alternative, as flushing of livestock is not required.

Under Alternative C, adverse impacts to BLM special status plant species from OHV use are anticipated to be the greatest of all the alternatives because Alternative C has the least acreage closed to motorized vehicle use, the second greatest acreage limited to existing roads and trails, the second least acreage limited to designated roads and trails, and the greatest acreage open. Permitting off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations would result in impacts similar to those described for Alternative A, but to a greater extent by allowing the creation of new travel routes. The anticipated soil disturbance, vegetation removal, and transport of invasive species under Alternative C are expected to produce the most indirect and adverse impacts to unknown populations of BLM special status plant species compared to other alternatives.

Similar to alternatives A and D, livestock grazing is closed on Bighorn River tracts, campgrounds, and exclosures. Alternative C may result in greater adverse impacts to Ute ladies'-tresses and persistent sepal yellowcress than alternatives A, B, and D by allowing placement of forage supplements in riparian/wetland areas. Alternative C (and Alternative D) allows the placement of forage supplements after considering the location of BLM special status plant species, which may increase the risk of herbivory and trampling. In addition, Alternative C places more emphasis on livestock forage availability

while meeting multiple use objectives. Overall, adverse impacts to BLM special status plants from livestock grazing management under Alternative C are anticipated to be similar to alternatives A and D and greater than Alternative B.

Special Designations

Under Alternative C, only the existing Brown/Howe Dinosaur Area and Spanish Point Karst ACECs are carried forward and no new ACECs are designated. No BLM special status plant species are known to occur in either ACEC. Therefore, beneficial impacts to special status plants from designation and management of ACECs would be the least under Alternative C.

Under Alternative C, does not recommend any WSR eligible waterway segments as suitable for inclusion in the NWSRS. By releasing these areas for other uses to be managed in accordance with adjacent BLM-administered lands, the potential for adverse impacts to Ute ladies'-tresses and persistent sepal yellowcress is greater than alternatives A and B.

Resources

Alternative C includes additional protective measures for soils compared to Alternative A, so that reclamation plans are developed on a case-by-case basis and 30 percent desired vegetative cover is required within three growing seasons. The anticipated level of soil erosion and compaction are expected to be similar to Alternative A.

While Alternative A may fence springs and reservoirs, Alternative C may fence springs and their associated wetland areas, potentially increasing the beneficial impacts to BLM special status plant species in these habitats. Alternative C manages for adequate in-stream flow to support riparian and fisheries values, which may provide fewer beneficial impacts than maintaining natural flow regimes as under alternatives A, B, and D. Because Alternative C only implements BMPs on permitted activity plans to reduce sediment loading in streams and river segments, it would have fewer beneficial impacts to BLM special status plant species than alternatives A, B, and D.

Under Alternative C, the BLM utilizes wildland fire and other vegetation treatments to restore fire-adapted ecosystems, similar to Alternative B, except that under Alternative C active restoration is used, which may create a greater beneficial impact than natural processes alone. This may result in more beneficial impacts to Hyattville milkvetch than Alternative A. Wildland fire and other vegetation treatments could be used to reduce the invasion of Utah juniper into Hyattville milkvetch habitat.

Alternative C may result in similar beneficial impacts to BLM special status plants in riparian/wetland habitats as Alternative A because both alternatives manage these habitats to meet PFC. In addition, Alternative C prioritizes areas functioning at-risk with a downward trend and areas in a nonfunctioning condition. However, Alternative C allows surface-disturbing activities in riparian/wetland areas on a case-by-case basis, potentially increasing adverse impacts to BLM special status plants in these areas. Through these management actions, the potential for direct removal of BLM special status plants, sedimentation, and spread of invasive plants is greater than under alternatives A, B, and D. Similar to Alternative A, Alternative C does not apply an NSO restriction to wetland areas greater than 40 acres.

Alternative C provides fewer protections to big game crucial winter range, parturition areas, and migration corridors than alternatives A, B, and D. By allowing activities in these areas, Alternative C results in the fewest beneficial impacts to BLM special status plants in these areas because these species may be removed or trampled.

Proactive Management

Alternative C sets aside the least amount of land of any alternative for areas that have management actions to benefit BLM special status plant species. Similar to Alternative B, buffers and restrictions for other resources and surface-disturbing activities around BLM special status plant species will likely provide indirect beneficial impacts to habitats for special status plants. Range improvement projects are not allowed within ½ mile of known BLM special status plant species, forage supplements are prohibited within 300 feet of BLM special status plants, and aerial applications of pesticides are prohibited with ½ mile of BLM special status plants, but surveys are only required in potential habitats for federally listed, proposed, or candidate species before approving any project. The increased buffers and requirement of some surveys compared to Alternative A aid in habitat protection and the potential expansion of the special status plant populations.

Alternative D

Surface Disturbance

Under Alternative D, BLM actions are projected to result in 140,507 acres of short-term surface disturbance on BLM-administered land and 18,443 acres of surface disturbance over the life of the plan, the second most acreage compared to the other alternatives. However, similar to Alternative B, Alternative D reduces the potential for habitat fragmentation by maintaining large, contiguous blocks of native plant communities. Although the BLM allows the use of nonnative seeds that may slow the reestablishment of native plant communities, reclamation practices under Alternative D, would mitigate short-term impacts of surface disturbance more than under Alternative A. Overall, surface disturbance under Alternative D would result in impacts similar to those under Alternative A.

Resource Uses

Alternative D has approximately 257,512 acres open to oil and gas leasing subject to the terms and conditions of the standard lease form, approximately one-fifth of the acreage under Alternative A, and has almost two times more acreage administratively unavailable to oil and gas leasing than under Alternative A. Minerals development under Alternative D would result in fewer adverse impacts to BLM special status plant species than under alternatives A and C, but more than under Alternative B.

Adverse impacts from management of invasive species under Alternative D would be similar to those under Alternative A. Alternative D results in more surface disturbance than Alternative A, leaving more areas vulnerable to invasive species spread, but employs more measures to restore vegetation in disturbed areas and places more restrictions on motorized travel that can spread invasive species.

Alternative D manages 22,413 fewer acres as ROW exclusion areas than Alternative A but approximately 2½ times more acreage as ROW avoidance/mitigation areas, which would result in more beneficial impacts to special status plant species than under alternatives A and C, but less than under Alternative B.

Under Alternative D, adverse impacts to BLM special status plant species from motorized vehicle use would be more than under Alternative B, but less than under alternatives A and C because Alternative D closes a similar amount of acreage to motorized vehicle use as Alternative A but designates the second-most acreage—a 34 percent increase compared to Alternative A—as limited to designated roads and trails. Restricting off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations to within 300 feet of established roads would limit the adverse impacts described under Alternative A.

Impacts from livestock grazing management under Alternative D would be similar to those under Alternative A. Allowing the use of livestock grazing, even in closed areas, as a tool to improve resource conditions may beneficially affect BLM special status plant species if grazing is used to enhance native plant communities.

Special Designations

Special designations under Alternative D would result in similar beneficial impacts as those under Alternative B, but to a lesser extent. Alternative D carries forward the Five Springs Falls, Upper Owl Creek, Carter Mountain, and Little Mountain ACECs, and proposes designating the Clarks Fork Canyon and Sheep Mountain ACECs. Alternative D would designate more acreage in ACECs than alternatives A and C, but less than Alternative B. Not recommending WSR eligible waterway segments as suitable for inclusion in the NWSRS would result in similar potential adverse impacts as those under Alternative C.

Resources

Alternative D includes additional protective measures for soils compared to alternatives A and C, but less than Alternative B. Alternative D requires reclamation plans, stipulations, or measures before authorized surface-disturbing activities and develops reclamation plans in coordination with stakeholders. The anticipated level of soil erosion and compaction are expected to be less under Alternative D than under alternatives A and C, but more than under Alternative B.

Similar to Alternative A, Alternative D does not require the maintenance of natural flow regimes for streams supporting fisheries, which would result in similar adverse impacts. Developing watershed improvement projects and fencing springs, wetlands, reservoirs, and riparian areas to meet resource objectives would result in similar beneficial impacts to those under Alternative B.

Fire and fuels management under Alternative D would result in impacts to BLM special status plant species similar to those under Alternative A.

Alternative D would result in beneficial impacts to BLM special status plant species in riparian/wetland habitats similar to Alternative A, but to a greater extent because the BLM manages areas with unique fisheries or recreational value toward achieving DFC. Management toward DFC is assumed to exceed the requirements of managing toward PFC and would therefore result in improved functioning and healthier riparian/wetland areas. Avoiding surface-disturbing activities within 500 feet of riparian/wetland areas and ¼ mile of sensitive riparian/wetland areas would reduce adverse impacts to BLM special status plant species in these areas similarly to Alternative A. Alternative D also applies an NSO on wetlands greater than 20 acres, resulting in similar beneficial impacts as those under Alternative B, but to a greater extent.

Alternative D provides similar beneficial impacts as those under Alternative B by establishing the Absaroka Front Management Area, but to a lesser extent. Alternative D restricts mineral development in this area less than Alternative B—by using a mix of CSU, TLS, NSO, and unavailable for leasing restrictions—but more than Alternative C and Alternative A (under which this management area is not recognized). Potential adverse impacts to special status plant species from wild horse grazing under Alternative D would be similar to those described under Alternative B.

Proactive Management

Alternative D avoids range improvement projects that may concentrate herbivory within ¼ mile of BLM special status plant species, unless the project is determined not to adversely impact that population; allows the placement of forage supplements after considering their proximity to BLM special status plant species; implements avoidance and mitigation measures for projects and activities in coordination

with surface owners on split-estate; avoids aerial applications of herbicides within ½ mile of BLM special status plant species; and allows the application of fire suppression chemicals within ¼ mile of known/documented populations of BLM special status plant species with consent of the authorized officer. Overall, these measures would result in more beneficial impacts to BLM special status plant species than alternatives A and C, but less than Alternative B.

4.4.8 Special Status Species – Fish

Adverse impacts are those that degrade water quality (e.g., temperature, chemistry, etc.) in the Planning Area, particularly where there are special status fish species. Beneficial impacts are those that improve and/or preserve water quality and quantity in these areas. Direct impacts are similar to those identified in Section 4.4.5 *Fish and Wildlife Resources - Fish* and include onsite disturbances to fish habitat, while indirect impacts result from changes in water quality and quantity.

For this analysis, short-term impacts to special status fish species include those activities that contribute to the decline in abundance or distribution of a species within 5 years of when the activity occurs. Long-term impacts to special status fish are those that require more than 5 years to manifest, such as efforts to improve habitat over time or remove competitive nonnative species.

In general, management actions that affect fish would also affect special status fish species. Section 4.4.5 *Fish and Wildlife Resources - Fish* provides a detailed analysis of direct and indirect management actions that impact fish. This section focuses on the potential impacts of the alternatives to special status fish species habitat (including habitat of the Yellowstone cutthroat trout, a BLM sensitive species), proactive management that could beneficially impact these species, and potential impacts to federally listed species downstream of the Planning Area.

4.4.8.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Water consumption in the Bighorn River and the Clarks Fork of the Yellowstone River watersheds may adversely affect surface water quantity in the larger Yellowstone River and Missouri River ecosystem.
- Produced water from CBNG drilling is assumed to have a negligible influence on surface water quantity and quality in the Bighorn River and the Clarks Fork of the Yellowstone River watershed due to a low likelihood that CBNG activities would occur at high levels in the Bighorn Basin.
- In cooperation with WGFD, the BLM would continue to manage species listed on BLM Wyoming State Director's Sensitive Species List in accordance with BLM manual 6840 (BLM 2001a).
- USFWS would have jurisdiction over the management of threatened and endangered fish and wildlife populations.

4.4.8.2 Summary of Impacts by Alternative

Impacts to special status fish species are generally the same as those for fish, although the beneficial impacts to these species would tend to be greater because of additional protective management for special status species under all alternatives. The principle impacts to fish result from management that increases surface disturbance, resulting in sedimentation and other adverse impacts to water quality and quantity in waterways containing special status species. Increased sediment in fish habitat (streams, rivers, and reservoirs) decreases the potential for fish to naturally reproduce, fills in pools, leads to channel degradation, decreases light penetration and productivity, alters fish community

composition, and increases stream temperature. Alternative C places the fewest restrictions on surface-disturbing activities and has the greatest potential to contribute sediment to surface waters in the Bighorn, Shoshone and Clarks Fork of the Yellowstone rivers, resulting in the greatest potential adverse impact on water quality in Yellowstone cutthroat trout and other special status species fish habitat. Alternative C is projected to result in the highest number of new federal wells (Appendix T), which may result in the greatest water depletion and, therefore, the greatest adverse impact to water quantity in these rivers followed by alternatives A, D, and B. Alternative D is projected to result in greater surface disturbance than Alternative A, but contains more stringent reclamation requirements that may limit erosion to a greater degree and, therefore, mitigate adverse impacts to fish habitat. Alternative B would result in the greatest beneficial impact to special status fish species habitat from more definitive proactive management actions and more stringent reclamation requirements relative to the other alternatives. Both alternatives B and D would provide long-term beneficial impacts by pursuing restoration of Yellowstone cutthroat trout to its native waters in the Planning Area.

4.4.8.3 Detailed Analysis of Alternatives

Allowable uses and management actions with potential to degrade water quality in the Bighorn and Clarks Fork of the Yellowstone Rivers and their tributaries could directly affect special status fish species in the Planning Area and indirectly impact federally listed fish in the Yellowstone River. The types of impacts projected to affect water quality and quantity in these watersheds are anticipated to be common to all alternatives and, therefore, are discussed in the following section. A detailed discussion of the anticipated impacts to fish from changes in water quality and quantity is included in Section 4.4.5 *Fish and Wildlife Resources - Fish*. This section focuses on the direct impacts to special status fish species habitat from proactive management, which varies by alternative.

Impacts Common to All Alternatives

The potential for management to result in adverse impacts to special status fish species is primarily a function of impacts to surface water quality and quantity. Reduced water flow in the Yellowstone River can lead to adverse impacts to the ecosystems that support special status fish species. Increased sediment in the Bighorn and Clarks Fork of the Yellowstone Rivers may contribute to sedimentation in the Yellowstone River.

Water Quality

Water quality is affected by surface-disturbing activities and associated soil erosion, particularly on soils highly susceptible to water erosion that contribute to sedimentation. Sedimentation reduces the quality of in stream habitat for most fish by filling in pools, reducing thermal recovery areas, and covering stream bottoms with a more uniform layer of sediment, which smothers eggs and alevin, thereby reducing fish reproduction rates. Appendix T provides data regarding surface-disturbance acreage and reasonable foreseeable actions related to development by alternative. Principle impacts from surface-disturbing activities would result from removing vegetation and disturbing soil, thereby increasing the potential for offsite erosion and sediment delivery into the Bighorn and Clarks Fork of the Yellowstone Rivers and their tributaries. Other actions, including concentration of livestock, fire and fuels management, OHV use, and reclamation of disturbed areas are anticipated to remove or reduce vegetation and disturb soil, but are expected to have less potential to degrade water quality in the Bighorn and Clarks Fork of the Yellowstone watersheds and therefore less potential to impact fish downstream. See Section 4.1.4 *Water* for more information regarding potential impacts to surface water quality.

Spanish Point Karst (designated under all alternatives) is the only ACEC that benefits water quality by restricting surface-disturbing activities and pesticide application in this area. WSAs contain 0.7 miles of occupied Yellowstone cutthroat trout habitat, and the restrictions on resource uses and activities to maintain their wilderness characteristics may result in indirect beneficial impacts to special status fish species under all of the alternatives.

Water Quantity

Water used for well construction and completion may reduce the amount of water available for use in the Bighorn and Clarks Fork of the Yellowstone Rivers, and therefore in the Yellowstone River downstream of the Planning Area as well. Produced water from oil and gas wells may alter flow regimes and water quantity in streams containing special status fish species. See Section 4.4.5 *Fish and Wildlife Resources - Fish* for a description of the impacts from produced water. Produced water from CBNG drilling is assumed to have a negligible influence on surface water quantity and quality in the Bighorn River and the Clarks Fork of the Yellowstone River watersheds. See Section 4.1.4 *Water* for more information regarding potential impacts to surface water quantity.

Alternative A

Surface Disturbance

The BLM projects 15,710 acres of long-term surface disturbance from BLM-authorized actions under Alternative A (Table 4-1) resulting in an estimated erosion rate of 25,167 tons per year (Appendix V). Surface-disturbing activities remove vegetation and disturb soil, thereby increasing the potential for offsite erosion and sediment delivery to the Bighorn, Shoshone, and Clarks Fork of the Yellowstone rivers, among the waterways in the Planning Area that drain into the Yellowstone River. Sedimentation fills in pools and covers stream bottoms with a more uniform layer of sediment that adversely affects special status fish species. Surface-disturbing activities would reduce water quality and degrade Yellowstone cutthroat trout and other special status fish species habitat in the Planning Area. The greater the surface disturbance, the greater potential for adverse impacts to special status fish species.

Resource Uses

Under Alternative A, 4,033,195 acres are available for locatable mineral entry, 863,564 acres are open with standard constraints for oil and gas leasing, and 3,975,695 acres are open to mineral materials disposal. This alternative would develop an estimated 1,130 new federal wells. Alternative A closes 59,192 acres to motorized vehicle use and limits motorized vehicle use to designated roads and trails in areas with fragile soils, limiting vehicle-caused soil disturbance and resulting contributions to sediment loads. Adverse impacts to special status fish species from sedimentation due to surface disturbance and erosion, depleted water quantity due to mineral development, and altered flow regimes due to soil compaction and produced water discharge would occur but would be mitigated under Alternative A.

Special Designations

Alternative A designates three ACECs, containing 9.8 miles of occupied Yellowstone cutthroat trout habitat that would benefit special status fish species by restricting surface-disturbing activities in these areas and reducing the likelihood of sedimentation in the associated watersheds. Managing all 20 WSR eligible waterways, containing 3.1 miles of Yellowstone cutthroat trout habitat, would result in beneficial impacts to special status fish species habitat relative to the other alternatives by restricting resource uses and activities to maintain the free-flowing nature of these waterways. However, WSR eligible waterway segment management may prevent construction of fish barriers to protect special

status fish species habitat, if the natural free-flowing nature of the stream would be impaired by these actions.

Resources

Under Alternative A, the BLM requires the stabilization of existing watershed improvement projects where they have failed to promote/enhance/improve watershed stability, and routinely seeds, or requires permittees and operators to seed, disturbed areas with native plant species to reestablish vegetation cover over disturbed soils within 5 years. These actions would beneficially impact special status species fishbearing streams by reducing sedimentation. Alternative A implements watershed improvement practices from Wyoming's Bighorn Basin water quality plans and encourages natural flow regimes in streams supporting fisheries in compliance with the state's water laws, providing potential indirect beneficial impacts to special status fish species. Surface discharge under Alternative A may have adverse impacts if produced water degrades water quality in special status fish species inhabited streams and rivers. Alternative A places restrictions on surface-disturbing activities around riparian/wetland areas. Forest management under Alternative A allows for 30,000 acres of treatment that could contribute to soil disturbance and sedimentation in the short term, but may have beneficial impacts by preventing stand-replacing wildfires, which may cause much more sedimentation, in the long term. Overall, resource management actions under Alternative A would result in beneficial impacts to special status fish species.

Proactive Management

Proactive management actions that have direct beneficial impacts to special status fish under Alternative A include restoring stream segments for fisheries habitat, constructing barriers to prevent nonnative fish from colonizing habitat occupied by native fish species, and introducing special status fish species to waters outside of their historic range on a case-by-case basis. Additional long-term beneficial impacts may result from considering restoring Yellowstone cutthroat trout to its native waters in the Planning Area. Prohibiting surface-disturbing activities within 500 feet of surface water and/or riparian habitat except when impacts can be mitigated would limit direct adverse impacts to special status fish species habitat.

Alternative B

Surface Disturbance

Impacts to special status fish species would be similar to those described under Alternative A, although to a lesser extent. Surface disturbance under Alternative B would be the least of the alternatives (Table 4-1) resulting in a 31 percent decrease in long-term erosion (Appendix V) and, therefore, the least adverse impact to special status fish species.

Resource Uses

Compared to the other alternatives, Alternative B allows fewer opportunities for resource use that result in surface disturbance and more restrictions are placed on mineral and ROW development, motorized vehicle use, and livestock grazing. Overall, Alternative B has the least potential to result in adverse impacts to special status fish species due to resource uses that can affect water quality or quantity.

Special Designations

The special designations under Alternative B have the greatest beneficial impact to special status fish species. Alternative B expands three ACECs (Carter Mountain, Five Springs Falls, and Upper Owl Creek)

and designates four new ACECs (Chapman Bench, Clarks Fork Canyon, Rattlesnake Mountain, and Sheep Mountain) that restrict surface-disturbing activities. The Clarks Fork Canyon ACEC protects a large portion of Clarks Fork of the Yellowstone watershed from the adverse impacts of surface-disturbing activities and mineral development, resulting in the greatest direct beneficial impacts to special status fish species in the Yellowstone River. ACECs encompass 42.7 miles of Yellowstone cutthroat trout habitat. Managing all 20 WSR suitable waterways would result in similar impacts to those under Alternative A. Additionally, designating all LWCs as Wild Lands and restricting resource uses and activities in these areas to protect wilderness characteristics may beneficially impact 8.8 miles of Yellowstone cutthroat trout habitat under this alternative.

Resources

Similarly to Alternative A, Alternative B stabilizes watershed improvement projects if they are no longer meeting resource objectives to prevent the release of stored sediment. Alternative B provides greater short-term beneficial impacts to special status fish species habitat than Alternative A by requiring more immediate and precisely defined vegetation reestablishment goals in disturbed areas, thereby preventing potential sedimentation. Alternative B also creates greater beneficial impacts than the other alternatives by developing watershed improvement practices, which all activity plans and permitted activities include, in cooperation with local governments. The BLM manages forests and woodlands through natural processes under Alternative B, as opposed to mechanical treatments emphasized under other alternatives, likely resulting in less surface disturbance and impacts to water quality in the short term. However, if maintained stand density results in high intensity wildfires, long-term adverse impacts to water quality and flow regimes may result. Alternative B manages all riparian/wetland areas to achieve DPC, providing the greatest long-term potential beneficial impacts to special status fish species habitat, relative to the other alternatives.

Proactive Management

Proactive management actions under Alternative B would result in greater direct beneficial impacts to special status fish compared to the other alternatives. This alternative restores important fisheries habitat on 3 miles of streams, constructs nonnative fish barriers except in WSR suitable waterway segments, removes barriers or constructs fish passageways to enable native fish to occupy all suitable habitats, pursues restoring Yellowstone cutthroat trout to all its original waters, and introduces special status fish species outside their historic range, if environmentally feasible, in coordination with WGFD and other stakeholders.

Alternative C

Surface Disturbance

Adverse impacts to special status fish species from surface disturbance would be greatest under Alternative C. Surface disturbance under Alternative C would be the highest of the alternatives (Table 4-1), resulting in a 164 percent increase in long-term erosion (Appendix V) compared to Alternative A and, therefore, the greatest adverse impact to special status fish species.

Resource Uses

Alternative C provides the least restriction on resource use, especially surface-disturbing activities such as minerals development, having the greatest potential adverse impact on special status fish species by altering water quantity and quality. The BLM manages livestock grazing to optimize commodity production while meeting rangeland health standards, not to enhance other resource values, resulting

in the greatest potential adverse impacts to special status fish species from riparian/wetland area degradation and vegetation removal that can impact water quality and quantity.

Special Designations

Other than the Spanish Point Karst ACEC, the Brown/Howe Dinosaur Area ACEC is the only ACEC designated under Alternative C; this ACEC may have a beneficial impact by preventing sedimentation in waterways as surface-disturbing activities must be mitigated, but management of the ACEC generally allows mineral development and other types of surface-disturbing activities that may affect water quality. ACECs under this alternative contain only 0.2 miles of Yellowstone cutthroat trout habitat. In addition, Alternative C does not recommend any WSR eligible waterway segments as suitable for inclusion in the NWSRS. Under Alternative C, special designations do not provide any substantial beneficial impact to surface water quality or fisheries habitat, and therefore this alternative has the least potential to beneficially impact special status fish species.

Resources

Alternative C only stabilizes watershed improvement projects if they are not meeting resource objectives, on a case-by-case basis. Alternative C applies less stringent restoration requirements than Alternative B to limit soil erosion in disturbed areas. The BLM does not implement watershed improvement plans (BMPs are relied on to mitigate adverse impacts) under Alternative C, providing the least potential beneficial impacts to special status fish species compared to the other alternatives. Forest management treatments emphasize commercial and economic objectives, resulting in the greatest potential impacts to water quality, compared to the other alternatives.

Proactive Management

The proactive management actions that result in direct beneficial impacts to special status fish under Alternative C are similar to those under Alternative A, except that the BLM only restores stream segments with special status fish species on a case-by-case basis and does not construct nonnative fish barriers. Alternative C provides the fewest beneficial impacts to special status fish species from proactive management compared to the other alternatives.

Alternative D

Surface Disturbance

Impacts to special status fish species from surface disturbance would be similar to those described under Alternative A. The projected surface disturbance is slightly more under Alternative D—estimated to result in a 17 percent increase in long-term erosion compared to Alternative A (Appendix V)—but reclamation and restoration practices are likely to limit erosion and sedimentation more than under Alternative A.

Resource Uses

Alternative D allows fewer opportunities for resource use that can result in surface disturbance than Alternative C. The BLM places more restrictions on minerals, ROWs, and motorized vehicle use under Alternative D than under alternatives A and C. Livestock grazing management under Alternative D would result in impacts similar to those under Alternative A. Overall, Alternative D has more potential to result in adverse impacts to special status fish species than Alternative B, but less than alternatives A and C.

Special Designations

Special designations under Alternative D would have a greater beneficial impact to special status fish species than under alternatives A and C, but less than under Alternative B. Alternative D designates the Clarks Fork, PETM, and Sheep Mountain ACECs in addition to the ACECs designated under Alternative A, containing 10.7 miles of Yellowstone cutthroat trout habitat, and applies additional resource use restrictions in the Chapman Bench Management Area to minimize impacts to special status species. Additionally, designating 52,485 acres of LWCs as Wild Lands and restricting resource uses and activities in these areas to protect wilderness characteristics may beneficially impact 7 miles of Yellowstone cutthroat trout habitat. Alternative D does not recommend any WSR eligible waterway segments as suitable for inclusion in the NWSRS. Special status fish species habitat would not be protected to the same degree in these areas as under alternatives A and B. However, the BLM could construct fish barriers on these waterways to prevent the spread of nonnative fish species that may adversely impact special status fish species.

Resources

Management actions to stabilize watershed improvement projects and reestablish vegetation in disturbed areas under Alternative D would result in similar beneficial impacts to those under Alternative A, but to a greater extent. Watershed improvement practices would result in similar beneficial impacts to those under Alternative B. Forest management would result in impacts similar to those under Alternative A, but there would be more potential adverse impacts from allowing clear cutting, similar to Alternative C. Management of riparian/wetland resources under Alternative D would be similar to Alternative C. However, managing streams with unique fishery values to meet DFC would result in greater beneficial impacts to special status fish species in these areas. Under Alternative D, the BLM would place more restrictions on surface-disturbing activities near riparian/wetland areas, which would limit impacts to a greater extent. Overall, resource management under Alternative D would result in more beneficial impacts to special status fish species than alternatives A and C, but fewer than Alternative B.

Proactive Management

Proactive management actions under Alternative D would result in similar beneficial impacts to special status fish species as under Alternative B, but to a lesser extent because the BLM would perform similar management actions, but on a priority basis. Surface-disturbance restrictions would limit direct adverse impacts to special status fish species habitat similarly to Alternative A. Pursuing the restoration of Yellowstone cutthroat trout to historically occupied watersheds would result in similar beneficial impacts to those under Alternative B.

4.4.9 Special Status Species – Wildlife

Direct impacts to special status wildlife species result from the direct loss of important habitat or a key habitat feature, such as a nest site or lek area, or from the immediate loss of life. Human activities can directly disturb special status wildlife, potentially causing nest, lek, or home range abandonment. Disturbance during sensitive periods (e.g., winter and breeding) leads to lower recruitment rates and higher mortalities, which results in adverse impacts to special status wildlife species.

Discussed in detail in the introduction to Biological Resources in this chapter and in Chapter 3, habitat loss and fragmentation result in adverse impacts to special status wildlife species. Habitat loss generally results in direct impacts to the individual or population that is immediately affected. The impacts of habitat fragmentation, however, operate indirectly through mechanisms such as population isolation

(Saunders et al. 1991); edge effects, such as increased nest predation and parasitism (Paton 1994; Faaborg et al. 1995); encroachment of invasive species; and disruption of migration patterns.

Special status wildlife experience indirect impacts through changes in habitat characteristics or quality, which ultimately can change migration patterns, habitat use, carrying capacity, and long-term population viability. Indirect impacts to habitats for special status wildlife species can also occur when specific actions change habitat to make it unsuitable. Disturbance impacts can range from short-term displacement and shifts in activities to long-term abandonment of home range (Miller et al. 1998; Warmoloy et al. 1988; Connelly et al. 2000).

For the purpose of this analysis, short-term impacts (up to 5 years) to special status wildlife are those activities that an individual or species respond to immediately, but do not impact the population viability of the species. Long-term impacts (more than 5 years) are those that cause an individual or species to permanently abandon an area, or that alter the population viability and survival of the species. Examples of beneficial long-term impacts include restoration of habitat structure or health, or enhancement of forage base to improve populations of special status wildlife species over time.

4.4.9.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Impacts to special status wildlife species are based primarily on potential impacts to habitats managed by the BLM.
- Precise quantitative estimates of impacts generally are not possible because the exact locations of future actions are unknown, population data for special status wildlife species are often lacking other environmental variables, or habitat types affected by surface-disturbing activities cannot be predicted.
- The more habitat available for a species, the greater the benefit to the targeted species.
- Prohibiting all surface-disturbing and disruptive activities in greater sage-grouse seasonal habitats is more beneficial to greater sage-grouse than avoiding these activities, as avoidance provides discretion for each proposed activity and applies mitigations, where prohibition precludes all activity.
- Within historical fire regimes, prescribed fire is used to manage vegetative communities and can result in short-term adverse impacts with long-term beneficial impacts to wildlife, certain desirable wildlife habitats, and in some cases to forage productivity and availability.
- Measures to protect one species generally result in long-term benefits to other species in that habitat.
- Short- and long-term surface disturbance are assumed to occur in vegetation types in proportion to the availability of these vegetation types in the Planning Area. Impact acreage for vegetation types are not absolute, but serve as a relative comparison among alternatives.
- Because of the migratory nature and relative mobility of some special status wildlife species (e.g., waterfowl, neotropical migrants, and raptors), these species are affected by actions on non BLM-administered land more so than other species. In the case of migratory species, impacts to winter and migration habitats could adversely impact the viability of some species. Winter and migration habitats are assumed to be at least as important to long-term viability of these species as breeding and nesting habitats.
- Removal of sagebrush habitat will have a long-term adverse impact on sagebrush-obligate species in the 5- to 9-inch precipitation zone.

- The USFWS may designate additional wildlife species as threatened and endangered as additional data are collected and evaluated. These species would be managed in accordance with the ESA and as directed by decisions in the alternatives.

4.4.9.2 Summary of Impacts by Alternative

Impacts to special status wildlife species are generally the same as those for wildlife and include habitat loss and fragmentation (adverse impacts) from surface disturbances and protection of habitat through management that increases restrictions in known or potential habitat (beneficial impacts). Overall, Alternative B is projected to result in the least surface disturbance and would have the least potential to cause habitat loss and fragmentation in the short- and long-term, followed by alternatives A, D, and C respectively. Alternative B provides the greatest beneficial impacts to special status wildlife habitats by including the most proactive actions to restore and enhance habitats. Except for seasonal motorized vehicle restrictions in the Absaroka Front Management Area, Alternative C would have the greatest adverse impacts to wildlife habitats and, therefore, the fewest beneficial impacts for special status wildlife species. Alternatives A and D would be similar in terms of surface disturbance, though the mitigation and reclamation requirements under Alternative D may lead to fewer impacts than Alternative A. Alternative B and, to a lesser extent, Alternative D benefit special status wildlife species by protecting large areas of contiguous native habitats in the Absaroka Front Management Area, ACECs, and LWCs designated as Wild Lands; alternatives A and C, respectively, would protect fewer large blocks of contiguous habitat. Alternatives C and D exempt Oil and Gas Management Areas (568,164 acres under Alternative C and 134,214 acres under Alternative D) from seasonal wildlife restrictions, resulting in adverse impacts to special status wildlife species.

Livestock grazing management under Alternative C would adversely affect grizzly bears and gray wolves the most, followed by alternatives A, D, and B. Gray wolves would benefit more from forest, woodland, and forest products management under alternatives A and D and less under alternatives B and C. Timber harvesting practices, old-growth stand retention, surface-disturbance restrictions around raptor nests, and snag retention under Alternative B would result in the most beneficial impacts to Canada lynx, followed by alternatives D, A, and C.

Alternative B protects the largest area of greater sage-grouse leks, nesting and early brood-rearing habitats, and winter concentration areas, followed by alternatives D, A, and C. Alternative B and, to a lesser extent, Alternative D place comparatively greater restrictions on resource uses and activities in greater sage-grouse Key Habitat Areas (Table 4-9). Although livestock grazing in greater sage-grouse habitat can have both adverse and beneficial impact (e.g., Alternative D allows livestock grazing to improve greater sage-grouse habitat), the more restrictive management under Alternative B would be the most beneficial to this species. Other sagebrush-dependent species (e.g., Brewer's sparrow, sage sparrow, and sage thrasher) are anticipated to benefit the most from protective management actions for greater sage-grouse under Alternative B, followed by alternatives D, A, and C.

Alternative B protects the largest area around active raptor nests (including a year-round CSU stipulation around all nests) and would be the most beneficial to these species, followed by alternatives A, D, and C respectively. Alternative C does not prohibit activities that may potentially disturb raptor nesting sites, and therefore protects the smallest amount of land for raptor nests. Adverse impacts to bald eagles from livestock grazing and surface disturbance would be greatest under Alternative C, followed by alternatives A, D, and B. Impacts from recreation in riparian/wetland areas to this species would be greatest under Alternative A, followed by alternatives B, D, and C. Proactive management actions in the Chapman Bench area under alternatives B and D would beneficially affect the mountain plover and long-billed curlew. Although livestock grazing and vegetation management under Alternative C is most

beneficial to the mountain plover, adverse impacts to prairie dogs under this alternative would result in adverse impacts to the mountain plover as well.

4.4.9.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

The types of projected impacts to special status wildlife species under the various alternatives are similar to the impacts described in Section 4.4.6 *Fish and Wildlife Resources - Wildlife*. Therefore, this section includes only instances where impacts are different from those described for wildlife. Authorized activities for resource uses may disturb special status wildlife species by causing displacement or excessive stress during critical life stages. Management actions and allowable uses under all alternatives would involve habitat loss, degradation, reclamation, protection, enhancement, and fragmentation. However, the intensity of impacts would vary by alternative. Refer to Appendix T for projected short- and long-term surface disturbance from BLM actions.

Resource Uses

Oil and gas development may result in adverse impacts to special status species, including the greater sage-grouse, under all alternatives. Increased bentonite mining, and potentially gypsum mining, along with the difficult nature of shrub reclamation in the 5- to 9-inch precipitation zone would result in adverse impacts to special status wildlife species in sagebrush habitat under all alternatives.

Avoiding the aerial application of pesticides, though minimizing drift into non-target areas in greater sage-grouse habitat, may result in adverse impacts in some situations because ground application can be a greater disturbance to greater sage-grouse. Avoiding pesticide application in greater sage-grouse breeding habitat during the brood-rearing season may preclude beneficial impacts if pesticides are necessary to control pests that would substantially reduce forage cover (e.g., grasshoppers).

Special status bird, raptor, and bat species can collide with wind-energy and utility infrastructure, causing a direct adverse impact due to mortality and displacement. Projected renewable energy development is the same for all alternatives (Appendix T), requiring the placement of these structures to minimize impacts. Large wind-energy fields involve surface disturbance, which could permanently change the habitat structure for the wildlife inhabitants.

Livestock grazing can alter special status wildlife species habitat resulting in adverse or beneficial impacts. Livestock grazing at the appropriate intensity and timing can be beneficial to grassland and shrubland habitats and the associated special status wildlife species, such as greater sage-grouse. In allotments where grazing by wild horses or livestock removes nest or brood cover, reduces the production of annual forbs, or restricts access to water, impacts to special status wildlife species, such as greater sage-grouse, would be adverse.

Special Designations

Special designations that restrict surface-disturbing activities and resource uses that adversely affect special status wildlife species, such as mineral development, motorized vehicle use, and ROW development provide beneficial impacts to these species. Under all alternatives, WSAs are managed for naturalness, outstanding opportunities for solitude, and primitive and unconfined recreation. These special designations provide multiple beneficial impacts by restricting activities and resource uses that degrade habitat and disturb special status wildlife species. The Spanish Point Karst ACEC, designated regardless of the alternative, would limit adverse impacts to special status bat species in this area.

Resources

Similar to livestock grazing, fire and fuels management can alter special status wildlife species habitat, resulting in adverse and beneficial impacts. Replicating historical fire regimes in grassland, shrubland, and forest and woodland habitats, although potentially resulting in adverse impacts to special status wildlife species in the short term, can prevent catastrophic wildfires likely to cause more adverse impacts, but only in areas where cheatgrass has not become prevalent and annual precipitation is sufficient to restore burned areas (e.g., above 12 to 14 inches annually). Wildland fire is used to restore fire-adapted ecosystems and in the long term improves forest health for many wildlife species such as mule deer and elk that summer and winter in these habitats. This in turn benefits special status wildlife species such as grizzly bears and gray wolves, which are predators of big game. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for a more detailed description of resource uses that impact wildlife.

Special status wildlife species are anticipated to benefit both directly and indirectly where restrictions are implemented that conserve different habitat types from surface-disturbing and wildlife-disturbing activities. For example, managing riparian/wetland areas to meet PFC improves habitat conditions for various special status wildlife species that inhabit these areas. Conservation of sagebrush habitat will not only benefit greater sage-grouse, it will benefit other sagebrush-dependent species such as the sage thrasher and sage sparrow.

Proactive Management Actions

Select management actions and allowable uses are anticipated to benefit special status wildlife species by promoting individual species and their habitats or by restricting or altering activities of other resource programs (e.g., mineral development, motorized vehicle use, and fire and fuels management). Collectively, this section describes these actions as proactive management actions, which include restricting certain types of development, managing habitat fragmentation, and developing and protecting water sources and associated habitats for special status wildlife species in cooperation with the WGFD.

Under all alternatives, implementing, where appropriate, conservation measures, terms and conditions, and appropriate BMPs and reasonable and prudent measures in existing state programmatic biological opinions for the bald eagle, Canada lynx, gray wolf, black-footed ferret, and grizzly bear would minimize and mitigate adverse impacts from resources uses and activities. Biological opinions are available on the project website at http://www.blm.gov/wy/st/en/programs/Planning/rmps/bighorn.html.

The greater sage-grouse is a BLM sensitive species known to occur in the Planning Area. Numerous management actions common to all alternatives from the *BLM National Sage-grouse Habitat Conservation Strategy* that would beneficially affect the greater sage-grouse by protecting and enhancing its habitat include: insecticide and pesticide restrictions, water source maintenance and protection, riparian/wetland area restoration, and vegetation treatments. All alternatives apply a protective buffer to restrict surface-disturbing activities around occupied greater sage-grouse leks and nesting and early brood-rearing habitat, providing beneficial impacts to greater sage-grouse and other sagebrush obligate species by protecting undisturbed sagebrush steppe habitats from potential mineral and industrial development. All alternatives apply a protective buffer around all active raptor nests, benefitting special status raptor species and other special status wildlife species that share this habitat.

The impacts to special status wildlife species are described under individual alternatives in terms of anticipated surface disturbance; the potential impacts from other resource uses, special designations and resource program actions; and proactive management followed by a more detailed description of impacts.

Alternative A

Surface Disturbance-Alternative A

In general, the impacts to special status wildlife species from surface disturbance parallel the impacts to all wildlife. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for a general discussion of these impacts. This section emphasizes what are likely to be the greatest impacts from surface disturbance to special status wildlife species.

Estimated short- and long-term surface disturbance from BLM actions in the Planning Area under Alternative A (Table 4-1) would result in loss, degradation, and fragmentation of sagebrush habitat. Loss of grassland and shrubland habitat will directly affect special status species that depend on these habitats. Surface disturbance, when it increases erosion and sedimentation, can also result in adverse impacts to special status wildlife species that depend on riparian/wetland habitats. Riparian/wetland habitat degradation due to surface disturbance is anticipated under Alternative A, which may result in adverse impacts to special status wildlife species inhabiting those areas.

Resource Uses-Alternative A

Minerals development would result in adverse impacts to special status wildlife species under Alternative A. Specifically, studies have identified mineral and oil and gas development as a potential cause of declining greater sage-grouse populations (Wyoming Sage-grouse Working Group 2003). Minerals development would result in 13,770 acres of long-term surface disturbance in grassland and shrubland communities under Alternative A that may result in habitat loss. Noise from mineral facilities operations, especially oil and gas facilities can also impact special status bird species relying on aural cues such as the greater sage-grouse. Alternative A is projected to result in 1,130 new federal oil and gas wells that would result in adverse impacts from habitat loss and noise disturbance.

Surface disturbance related to powerlines under Alternative A would be approximately 338 acres. Powerlines can directly affect raptor species through electrocution and current policy requires mitigating construction methods to avoid electrocution, when permitted on BLM-administered lands. Wind-energy development can also directly affect raptors and other birds through collisions and displacement, and indirectly through habitat fragmentation. Although renewable energy development across all alternatives is anticipated to be equal, Alternative A does not exclude wind-energy developments on any part of the Planning Area and the projected impacts to special status bird species from this resource use is greatest under this alternative.

Alternative A would limit impacts to special status wildlife species by closing 59,192 acres, including threatened and endangered species habitat, to motorized vehicle use that can disturb special status species. Projected surface disturbance from roads totals 1,966 acres in the short term and 983 acres in the long term under Alternative A, contributing to habitat loss and potentially forming barriers that fragment habitat for some special status wildlife species (Appendix T).

Livestock grazing under Alternative A is generally managed to provide for protection or enhancement of other resource values (e.g., wildlife). The BLM prohibits forage supplements within ¼ mile of riparian/wetland areas to avoid adverse impacts to this habitat. Special status wildlife species categories potentially affected by livestock and wild horse grazing include trophy game, game birds, nongame mammals, neotropical migrants, and amphibians.

Special Designations-Alternative A

Under Alternative A, the BLM designates the Five Springs Falls and Upper Owl Creek ACECs, which have special status species as a value of concern. Additionally, Alternative A restricts certain resource uses

and activities within WSR eligible waterway segments, which would beneficially impact special status species that use riparian habitat. Special designations would limit adverse impacts to special status wildlife species under Alternative A.

Resources-Alternative A

The impacts of resource management to special status wildlife species are addressed more specifically below. An overview of resource management as it applies to special status wildlife species habitat is included here under each alternative.

Fire and fuels management is likely to cause similar impacts to special status wildlife species across all alternatives. Under Alternative A, wildland fire is used to restore fire-adapted ecosystems and to reduce hazardous fuels, likely resulting in long-term beneficial impacts to all special status wildlife species, except in areas with lower precipitation, where wildland fire is not expected to enhance grassland or shrubland habitats.

Currently, the BLM manages invasive species primarily through cooperative efforts with county Pest Control Districts. Recent permitted activities under APDs, or ROWs, require weed treatment by the APD or ROW holder. Weeds have spread on public lands in developed oil and gas fields, along roads and pipelines, and with increasing recreational use. In general, Alternative A allows for expansion of these resource uses and is predicted to continue the spread of invasive species. The spread of invasive species is anticipated to degrade sagebrush and riparian/wetland habitats most acutely, and result in adverse impacts to special status wildlife species that depend on these habitats in the long term.

Forest management under Alternative A pursues some measures anticipated to disturb special status wildlife species and degrade/destroy habitat. These activities include precommercial thinning, woodland treatments, prescribed burns, timber harvest, and clear cutting limited to 300 yards in any direction. However, timber harvesting performed in a manner that protects and benefits wildlife would limit disturbance and reduce fuel loads to lower the risk of wildfire, providing long-term benefits. Special status wildlife species categories directly affected by forest management include raptors, mammals, and bats.

Under Alternative A, the BLM manages grassland and shrubland communities on a small portion of the Planning Area for watershed protection and livestock grazing without any specific management actions for improving these habitats for wildlife. Reclamation of grassland and shrubland vegetation, especially in lower precipitation zones, would minimize long-term impacts to special status wildlife species that depend on these habitats. Under Alternative A, the BLM reclaims disturbed areas by routinely seeding, or requiring permittees and operators to seed, these areas with native seed mixes without specific requirements regarding topsoil salvage, temporary protective surface treatments, or reclamation plans. Special status wildlife species categories directly affected by grassland and shrubland management and reclamation include the greater sage-grouse, raptors, neotropical migrants, and nongame mammals.

Alternative A provides riparian/wetland communities the third most protection, compared to other alternatives. All riparian/wetland areas are managed to meet, or make progress toward meeting, PFC. Special status wildlife species categories directly affected by riparian/wetland management and protection include raptors, neotropical migrants, mammals, and amphibians.

Proactive Management-Alternative A

In general, proactive management under Alternative A provides benefits and mitigates adverse impacts to special status wildlife species. Impacts due to proactive management, and other impacts, are described in detail under each special status wildlife species category below.

Trophy Game-Alternative A

The BLM implements, as appropriate, various measures from the existing state programmatic biological opinion for the grizzly bear to minimize adverse impacts to this species under all alternatives. Other measures included in Alternative A that may provide beneficial impacts to grizzly bear habitat include seasonal closures and restrictions on big game crucial winter ranges and migration corridors, seasonal surface-disturbance restrictions around raptor nests, protection of elk calving areas, and limitations of geophysical operations and other surface disturbances around greater sage-grouse leks, all of which may occur in grizzly bear habitat.

Livestock grazing management is likely to result in adverse impacts to grizzly bears as a result of accidental or illegal take (e.g., a herder shooting a bear attacking livestock) or bear removal by the WGFD due to livestock depredation. Conflicts have been more prevalent on sheep allotments and more difficult to resolve without phasing out sheep grazing (BLM 2005f). Under Alternative A, the Planning Area is open to livestock grazing except for Bighorn River tracts, campgrounds, and exclosures, which may result in adverse impacts to grizzly bears where livestock grazes in grizzly bear habitat.

Predatory Animals-Alternative A

Under Alternative A, there are no specific management actions for gray wolves; however, management actions that protect the habitat gray wolves and their prey (primarily elk) utilize are anticipated to benefit gray wolves in the Planning Area. Management actions limiting human activities, ROW development such as roads, and habitat fragmentation also will benefit gray wolves. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more detail on impacts to big game.

Under Alternative A, harvesting timber in a manner that protects and benefits wildlife habitat values would beneficially impact gray wolves by creating of patchwork pattern of forest stands that will enhance forage used by elk and other big game (BLM 2004f). However, new roads created for timber management may disturb and displace gray wolves with more human access. Closing spur roads after completion of timber management would limit these impacts.

Under Alternative A, management actions that may directly or indirectly minimize impacts to gray wolves include prescribed burns to enhance big game forage, prohibiting livestock grazing in elk parturition habitat during the birthing season unless the effects can be mitigated, applying a CSU stipulation in big game parturition habitat, and seasonally prohibiting surface-disturbing activities around active raptor nests. Alternative A also applies a CSU stipulation for big game migration corridors, indirectly benefitting gray wolves. These restrictions benefit gray wolves only where their habitats, or their prey's habitats, overlap.

Game Birds (Greater Sage-grouse)-Alternative A

Alternative A provides a protective buffer around occupied leks and seasonal restrictions in brood-rearing habitats and winter concentration areas, but does not provide specific guidance for the prevention of habitat loss and fragmentation. For example, developing minerals and wind-energy facilities on BLM-administered land under Alternative A may result in long-term adverse impacts to greater sage-grouse by fragmenting sagebrush habitats. Holloran et al. (2010) found that male greater sage-grouse yearlings were 4.6 times more likely to establish leks outside compared to inside areas with oil and gas infrastructure, and yearling female avoidance responses indicated a loss of functional nesting habitats within 3,000 feet of the infrastructure of natural-gas fields. These results suggest that conventional oil and gas development adversely affects greater sage-grouse by excluding individuals from developed areas. Alternative A closes 37,933 acres of greater sage-grouse Key Habitat Areas to oil and gas development to limit these impacts (Table 4-9). Alternative A does not include restrictions for

the development of wind energy; however, any proposal for a renewable energy ROW would be analyzed on a site-specific basis, and appropriate mitigations (seasonal restrictions or buffer areas) would be applied in accordance with current greater sage-grouse habitat management policy. Overall, surface disturbance in sagebrush habitats under Alternative A is anticipated to result in adverse impacts to greater sage-grouse in the short and long term.

Although the extent of sagebrush habitat degradation from the spread of invasive species and other weeds is unknown for the Planning Area, the potential for these species to substantially affect greater sage-grouse habitats in the future exists (Wyoming Sage-grouse Working Group 2003). Therefore, the anticipated continued expansion and spread of invasive species under Alternative A would result in adverse impacts to greater sage-grouse and sagebrush habitats.

By altering habitat components necessary for greater sage-grouse habitats, livestock grazing can affect the suitability and extent of greater sage-grouse habitats in the Planning Area (Wyoming Sage-grouse Working Group 2003). While livestock grazing management has a limited effect on sagebrush, it is important because it affects the height and density of herbaceous material available for greater sage-grouse cover. Livestock grazing on greater sage-grouse habitat consists of both long-term management to promote desirable plant communities and annual management of the standing crop to provide cover for the greater sage-grouse, requiring management of the timing and intensity of grazing (BLM 2003b). Monitoring is important to ensure grazing intensity and duration does not remove required herbaceous cover and litter important for maintaining greater sage-grouse habitats. Although rangeland productivity is improving in the Planning Area, the current focus of management and monitoring does not emphasize the protective cover of vegetation and litter required by greater sage-grouse. Therefore, management of livestock grazing under Alternative A may not improve the quality or quantity of habitats for greater sage-grouse, but should maintain current habitats. Livestock grazing management can maintain healthy rangeland conditions that provide habitat (i.e., nesting, brood-rearing, and summer habitat) when properly designed and monitored (Crawford et al. 2004). Year-long grazing by wild horses in HMAs does not contribute to improving the quality or quantity of habitats for greater sage-grouse.

ACECs designated under Alternative A would encompass 20,461 acres of greater sage-grouse Key Habitat Areas (Table 4-9). The associated restrictions on resource uses and activities in these areas would beneficially impact greater sage-grouse.

To minimize impacts to sagebrush habitats and greater sage-grouse, proactive management actions under Alternative A prohibit surface-disturbing discretionary actions within ¼ mile of occupied leks and avoid surface-disturbing and disruptive activities within 2 miles of occupied leks or in identified greater sage-grouse nesting and early brood-rearing habitats. Table 2-2 identifies the acreage protected by these buffers. Braun (2002) indicates that adverse impacts to greater sage-grouse can occur within ¼- or ½-mile buffers and accordingly recommends no surface disturbance within 3 miles of occupied leks. To protect greater sage-grouse winter concentration areas, the BLM avoids surface-disturbing and disruptive activities from November 15 to March 14. Overall, these actions are anticipated to limit adverse impacts to greater sage-grouse.

Nongame (Raptors)-Alternative A

Special status raptor species would be affected by surface-disturbing activities, fire and fuels management, invasive species spread, motorized vehicle use, livestock grazing (Johnson and Horn 2008 and Torre et al. 2007), and management actions for biological resources under Alternative A. The late winter, spring, and early summer periods, when courtship, nest construction, incubation, and early

brooding periods occur, would be more sensitive to disturbance because adult raptors are more prone to abandon nests at these times (USFWS 2002).

Surface disturbance causes localized adverse impacts to raptor prey species by temporarily and permanently disturbing habitats for small mammals and birds. Under Alternative A, no activity or surface disturbance is allowed for up to a ¾-mile radius from any active raptor nest from February 1 through July 31 to prevent nest disturbance and abandonment. Surface-disturbing activities are restricted at known bald eagle nests and communal winter roosts, but not in terrestrial foraging habitats, and therefore may adversely impact bald eagles (BLM 2003b) and other special status raptor species. Bald eagles are also directly affected by impacts to riparian/wetland habitat. See Section 4.4.3 *Vegetation - Riparian/Wetland Resources* and the *Nongame (Neotropical Migrants)* section for likely impacts to bald eagles.

Constructing roads, powerlines, and other development facilities can contribute to loss and fragmentation of raptor habitats and ultimately impacts the diversity and abundance of raptor populations (USFWS 2002). For example, utility poles can provide perching and nesting structures for raptors, but also can result in mortality to raptors through collision and electrocution (APLIC and USFWS 2005); current policy requires mitigation be applied to construction design for power poles permitted on BLM-administered land. Wind-energy facilities can be a source of mortality for raptors if they collide with wind tower blades. High mortality could result if wind towers are placed along a migration path or in nesting habitat. Wind-energy facilities also could be a source of habitat loss and fragmentation, and human disturbance from construction and maintenance activities. The ROD for Wind Energy Development (BLM 2005c), which guides management under Alternative A, provides BMPs to minimize impacts to raptors, but lacks specific guidelines to avoid adverse impacts. Likewise, wind-energy development is considered on a case-by-case basis and no areas are excluded from wind-energy development under Alternative A, so the potential impacts to raptors are greatest under this alternative.

As recreational use is often concentrated in riparian areas, human activity in these areas may cause bald eagles to avoid or abandon otherwise suitable habitats (BLM 2003b). Developing or upgrading recreation sites and establishing day use facilities at Wardel and Harrington reservoirs would adversely impact bald eagles under Alternative A. Similarly, managing the Bighorn River SRMA to maximize recreation opportunities may also adversely impact bald eagles due to disturbances from recreationists.

Livestock grazing in riparian/wetland areas may adversely impact bald eagles if soil erosion, degradation of stream bank conditions, introduction of noxious weeds, and the reduction of viable cottonwood tree sapling recruitment result (BLM 2003b). Under Alternative A, the Bighorn River tracts are closed to livestock grazing, limiting adverse impacts to bald eagles in these areas.

Special status raptors are affected by wildlife-disturbing activities that contribute to habitat loss, fragmentation, and degradation. Such actions include, but are not limited to, clear-cutting, snag removal, industrial activities, and invasive species control. For example, clear-cutting directly impacts raptor habitat for those raptors (e.g., northern goshawk) that prefer closed canopies. Other raptor species, such as ferruginous hawks, may benefit from openings in the canopy when in pursuit of prey. Snag removal indirectly affects raptors by degrading habitat and reducing potential nest sites. Alternative A allows for clear cutting and timber salvage of dead stands, which would adversely impact raptors by reducing habitat and nest sites. In the long term, the continued spread of invasive species in the Planning Area, combined with the loss and fragmentation of raptor habitats by wind energy, mineral development, and associated infrastructure projected under Alternative A, are expected to have adverse impacts to special status raptor species.

Nongame (Neotropical Migrants)-Alternative A

Although impacts to neotropical migrants on their winter habitat are not subject to BLM management, impacts to breeding and nesting habitats from surface-disturbing activities, invasive species management, fire and fuels management, and management actions for biological resources on BLM-administered lands are anticipated for these species. Where possible, site-specific assessments and discretionary permit actions will mitigate these impacts. Surface disturbance is anticipated to have localized adverse impacts to breeding and nesting habitats for neotropical migrants. Habitat impacts from surface disturbance may include temporary and permanent loss of breeding and nesting habitats due primarily to mineral development. Fragmentation and degradation of habitats for neotropical migrants also are anticipated from surface-disturbing activities and associated development and the spread of invasive species. In general, management actions and projected development under Alternative A are likely to result in adverse impacts to neotropical migrants from habitat loss, fragmentation, and degradation.

Because of the diverse species in the neotropical migrant category, the discussion below organizes these species into the following habitat guilds:

- Sagebrush and shrubland species: Brewer's sparrow, loggerhead shrike, sage sparrow, and sage thrasher
- Grassland species: Baird's sparrow, long-billed curlew, and mountain plover
- Riparian/wetland species: yellow-billed cuckoo, trumpeter swan, and white-faced ibis

Sagebrush and Shrubland Species – Similar to the greater sage-grouse, the Brewer's sparrow, sage sparrow, and sage thrasher depend on sagebrush habitats, though they may use other shrubland types, particularly during the nonbreeding season. The loggerhead shrike uses a more diverse mix of shrubland and grassland types, including sagebrush. There are no proactive management actions specific to sagebrush and shrubland neotropical migrants under Alternative A, but measures to protect greater sage-grouse discussed under Game Birds benefit all sagebrush and shrubland species. Adverse and beneficial impacts to sagebrush habitats discussed under *Surface Disturbance* and *Game Birds* apply to neotropical migrants that occur in similar habitats. Sagebrush and shrubland species may benefit from prescribed fire used to improve plant community health in shrubland communities, but only where healthy native vegetation and adequate annual precipitation (above 12 to 14 inches) are present. Any wildland fire occurrence in lower precipitation zones or where cheatgrass is present would likely reduce sagebrush and increase cheatgrass occupancy (Keeley 2006). In the long term, allowable uses resulting in habitat loss would adversely impact sagebrush and shrubland neotropical migrants, but management actions implemented under Alternative A would limit adverse impacts to these species.

Grassland Species – Grasslands make up less than 1 percent of the Planning Area. Under Alternative A, there are no management actions specific to special status neotropical migrants that utilize grasslands, other than the mountain plover. Refer to Section 4.4.2 *Vegetation - Grassland and Shrubland Communities* and Table 4-8 for a discussion of management actions and BLM-authorized activities that would impact grasslands and would similarly affect neotropical migrant habitat in these areas. Due to its projected long-term surface disturbance and reclamation requirements, Alternative A would result in habitat loss and degradation in grasslands.

Adverse impacts to the mountain plover would be minimized by implementing various conservation measures and BMPs under Alternative A. Mountain plovers are often found in association with prairie dog towns because they tend to prefer nesting areas with sparse vegetation cover, and therefore are affected by management actions for white-tailed prairie dogs (see *Nongame [Mammals]*). In addition,

mountain plovers show a nesting preference to areas heavily grazed by livestock (BLM 2005g). Range management practices that favor uniform grass cover of taller grasses and a lack of bare patches reduce available mountain plover habitats (BLM 2005g). Livestock grazing under Alternative A is likely to benefit the mountain plover.

Riparian/Wetland Species – Although there are no specific management actions for special status neotropical migrants that use riparian areas and wetlands, other biological resource management actions—particularly those pertaining to water and riparian/wetland areas, such as surface disturbance restrictions, livestock grazing and riparian area management, and special designations—would affect these species. While most surface-disturbing activities will not occur in riparian/wetland areas, adverse impacts, to a limited extent, may occur due to erosion and increased sedimentation in streams. Prohibiting the placement of salt, mineral, or forage supplements would limit adverse impacts from concentrated livestock to riparian/wetland areas. Refer to Section 4.4.3 *Vegetation – Riparian/Wetland Resources and* Table 4-8 for a description of other management actions and BLM-authorized activities that would impact wetlands and riparian areas and would similarly affect neotropical migrant habitat in these areas.

Nongame (Mammals)-Alternative A

Surface-disturbing activities, invasive species control, fire and fuels management, and management actions for biological resources may result in impacts to special status nongame mammals. Surface disturbance would have localized adverse impacts to special status nongame mammal habitats, including temporary displacement, and would fragment and degrade special status nongame mammal habitat.

It is important to note that some special status nongame mammal species, especially bats, may use more than one habitat type (e.g., caves and forests/woodlands). However, because of the diverse species in the special status nongame mammal category, the discussion below organizes these species into the following habitat guilds:

- Sagebrush and Shrubland Species: white-tailed prairie dog and black-footed ferret
- Forest and Woodland Species: Canada lynx
- Cave Species: Townsend's big-eared bat, spotted bat, and long-eared myotis

Sagebrush and Shrubland Species – Similar to the greater sage-grouse, special status nongame mammals in this category depend on sagebrush habitats or other shrubland types. Therefore, measures to protect greater sage-grouse as discussed under *Game Birds (Greater Sage-grouse)* would benefit all sagebrush and shrubland species. Likewise, adverse impacts to sagebrush habitats discussed for the greater sage-grouse would result in adverse impacts to these species. In the long term, actions implemented under Alternative A would benefit special status nongame mammals occupying sagebrush habitats in designated greater sage-grouse lek habitat buffers. Black-footed ferrets are associated with and depend on prairie dog colonies in the Planning Area. Due to the BLM's use of conservation measures, terms and conditions, and BMPs, measurable adverse impacts from BLM actions to prairie dog populations are not anticipated under Alternative A.

Forest and Woodland Species – Canada lynx prefer coniferous forests and riparian areas. Under Alternative A, there are no specific management actions for Canada lynx; however, management actions that protect the Canada lynx habitats and their prey (primarily snowshoe hare) may result in beneficial impacts to Canada lynx. For example, prohibition of surface disturbance within ¾ mile of active raptor nests conserves Canada lynx habitats during the TLS where these habitats overlap but would not provide long-term protection to Canada lynx. Maintenance of forest stands with dense vegetative cover (i.e.,

prohibiting precommercial thinning) is important to maintaining snowshoe hare populations and therefore the presence of Canada lynx in the Planning Area (USFS 2005b). Clear cutting, logging operations, road and landing construction, disease treatment sprayings, and fire and fuels management in aspen and coniferous forests may result in short-term adverse impacts to Canada lynx habitats by reducing large woody debris that may reduce cover, eliminate den sites, reduce kitten survival, and reduce the availability of prey species (e.g., snowshoe hare and red squirrel) (BLM 2005h; USFS 2005b). However, over the long term, treatments may improve habitat for Canada lynx and its prey species by diversifying forest structure and reducing fuel loads. Alternative A does not address old growth forest areas in the Planning Area, but ensures an appropriate level of snag retention and harvests timber in a manner that protects wildlife habitat values, minimizing adverse impacts to the Canada lynx.

Cave Species – Although bats can utilize a variety of habitats including riparian and forest habitat, cave and karst habitat and abandoned mines are of importance for most species. Bats that use caves for roosting, maternity colonies, or hibernation could be affected by surface-disturbing activities near caves, cliffs, or other rock features. Abandoned mine closures and recreational caving have been identified as the two major threats to bat habitats (Priday and Luce 1995). Alternative A allows activities in AMLs on a case-by-case basis, resulting in the second highest potential adverse impacts to bat habitat. Management that increases recreation and access to caves may result in adverse impacts to bats. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* and Section 4.1.5 *Cave and Karst Resources* for impacts to bats and their habitat. Similarly to raptors, bats are likely to be adversely affected by wind-energy development.

Nongame (Amphibians)-Alternative A

Special status amphibian species in the Planning Area are associated with riparian, wetland, woodland, and forested habitat and are susceptible to impacts from habitat degradation and fragmentation, pollution, and modified hydrology. Beneficial impacts to these species are similar to the impacts described under Nongame (neotropical migrants) for this alternative. The Great Basin spadefoot toad may be affected by activities in sagebrush communities, where this species occurs. Beneficial impacts to the Columbia spotted frog are similar to those described for greater sage-grouse for this alternative. Accordingly, Alternative A is likely to result in mitigated adverse impacts to special status amphibian species. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more information on impacts to amphibians.

Alternative B

Surface Disturbance-Alternative B

Estimated short- and long-term surface disturbance from BLM actions in the Planning Area (Table 4-1) would result in the least loss, degradation, and fragmentation of sagebrush habitat under Alternative B. Erosion from surface disturbance would cause the least impact to riparian/wetland habitats under Alternative B. Surface disturbance from roads totals 1,229 acres in the short term and 614 acres in the long term under Alternative B (Appendix T), forming fewer barriers to fragment habitat than Alternative A. Reclamation requirements are the most stringent under Alternative B, likely resulting in the highest degree of surface disturbance mitigation, compared to other alternatives.

Resource Uses-Alternative B

Minerals development under Alternative B would result in similar adverse impacts to special status wildlife species as under Alternative A, but to a lesser extent. Alternative B has the fewest acres open to mineral development, resulting in the least loss of shrubland and grassland habitat, compared to the

other alternatives. Alternative B is projected to result in 509 new federal oil and gas wells that would result in fewer adverse impacts from less habitat loss and noise disturbance than Alternative A.

Alternative B would have the least powerline development, resulting in the least potential risk of raptor electrocution. The BLM closes a portion of the Planning Area to wind-energy development (1,251,869 acres) and avoids raptor concentration areas and greater sage-grouse nesting, brood-rearing, and winter habitat. Powerline and wind-energy development would impact special status species the least under Alternative B.

Alternative B closes the greatest area to motorized vehicle use, which can disturb special status species, including threatened and endangered species habitat. Alternative B would result in the least potential disturbance of special status species due to motorized vehicle use.

Livestock grazing under Alternative B is generally managed to meet multiple use objectives over solely livestock forage availability. While livestock grazing would be restricted more under this alternative, this will not necessarily benefit special status species that depend on livestock grazing to increase range productivity and reduce vegetation height, such as the mountain plover. Alternative B prohibits forage supplements within ½ mile of riparian/wetland areas to minimize adverse impacts to this habitat. Special status wildlife species most likely affected by livestock grazing include greater sage-grouse, nongame mammals, neotropical migrants, and amphibians.

Special Designations-Alternative B

Three ACECs are expanded (Carter Mountain, Five Springs Falls, and Upper Owl Creek) and three new ACECs are designated (Chapman Bench, Clarks Fork Canyon, and Rattlesnake Mountain) with special status species values of concern under Alternative B, providing the greatest potential benefit to special status wildlife species. Alternative B manages WSR suitable waterway segments similarly to Alternative A, though places greater restrictions on resource uses and activities with proportional beneficial impacts to special status species in riparian habitat.

Resources-Alternative B

Fire and fuels management is likely to cause similar impacts to special status wildlife species across all alternatives. Under Alternative B, the BLM would use wildland fire to restore fire-adapted ecosystems and reduce hazardous fuels, likely resulting in long-term beneficial impacts to special status wildlife species in areas of higher precipitation. Due to the reliance on natural process before active restoration, achieving fire-adapted ecosystems is less likely under Alternative B. However, treatments are used in the WUI to protect structures from fire, potentially adversely affecting special status wildlife species in the short term if treatments require surface disturbance or alter vegetative cover, but benefitting them in the long term if treatments reduce the chance of catastrophic wildfire that could destroy greater expanses of habitat.

In general, Alternative B limits the expansion of resource uses, and therefore may result in the least amount of invasive species spread relative to the other alternatives. Invasive species would impact special status wildlife species the least under Alternative B.

Forest management under Alternative B, by generally pursuing natural processes to meet forest health goals, would adversely impact special status wildlife species the least from destroying or degrading habitat. Additionally, the BLM retains old growth forests, providing beneficial impacts to special status wildlife species, especially raptors and bats.

Grassland and shrubland management under Alternative B would provide the greatest potential beneficial impacts to special status wildlife species. Under Alternative B, the BLM manages grassland

and shrubland communities toward achieving 75 percent of Historical Climax Plant Community and maintains and enhances important plant communities on large, contiguous blocks of land. These measures are likely to result in the greatest natural vegetation diversity and slow the spread of invasive species, benefitting special status wildlife species, especially greater sage-grouse, nongame mammals, and neotropical migrants.

Alternative B provides riparian/wetland communities the most protection, compared to other alternatives. All riparian/wetland areas are managed to achieve DPC, likely resulting in the most diverse riparian/wetland habitat that will provide the greatest benefit to special status wildlife species.

The Absaroka Front Management Area, designated under Alternative B, provides additional habitat protection goals that would likely benefit special status wildlife species including neotropical migrants, raptors, bats, grizzly bears, and gray wolves that depend on upper-elevation shrub/grassland and forest habitats.

Proactive Management-Alternative B

In general, proactive management under Alternative B provides more benefits, and mitigates adverse impacts to special status wildlife species to a greater extent than alternatives A, C, and D. Impacts due to proactive management, in addition to other impacts, are described in more detail under each special status wildlife species category below.

Trophy Game-Alternative B

The BLM implements, as appropriate, various measures from the existing state programmatic biological opinion for the grizzly bear to minimize adverse impacts to this species under Alternative B. Alternative B includes other measures, similar to Alternative A that may provide beneficial impacts to grizzly bear habitat. The closure of the Absaroka Front Management Area to various resource uses is also likely to result in beneficial impacts to grizzly bears by reducing activities that can potentially fragment habitat.

Alternative B closes elk and bighorn sheep crucial winter range and greater sage-grouse Key Habitat Areas to livestock grazing and prohibits domestic sheep grazing on pronghorn crucial winter range. These management actions would beneficially impact grizzly bears in areas where grazing prohibitions overlap with grizzly bear habitat by reducing the potential for conflict that may result in accidental or illegal take or WGFD removal.

Predatory Animals-Alternative B

Under Alternative B, there are no specific management actions for gray wolves; however, management actions that protect the habitat gray wolves and their prey (primarily elk) utilize may benefit gray wolves in the Planning Area. Management actions limiting human activities, ROW development such as roads, and habitat fragmentation also would benefit gray wolves. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more detail on impacts to big game.

Harvesting timber only where natural processes are unable to accomplish forest health goals would minimize short-term impacts from disturbance and displacement to gray wolves, but may result in less long-term beneficial impacts than Alternative A by limiting widespread diversification of forest stand structure. Closing timber management roads not required for existing uses would benefit gray wolves by reducing human access and habitat fragmentation.

Under Alternative B, management actions that minimize adverse impacts to gray wolves include habitat enhancement projects in sagebrush communities, aspen restoration, prohibiting livestock grazing, applying a CSU stipulation in big game parturition habitat, and seasonally prohibiting surface-disturbing activities around active raptor nests. These restrictions benefit gray wolves only where the habitats

overlap. Under Alternative B, resource use restrictions in the Absaroka Front Management Area may be the most beneficial to big game, and therefore to gray wolves. Alternative B may result in the most beneficial impacts to gray wolves, relative to the other alternatives.

Game Birds (Greater Sage-grouse)-Alternative B

Under Alternative B, estimated short- and long-term surface disturbance from BLM actions in the Planning Area would result in less loss, degradation, and fragmentation of sagebrush habitats than under Alternative A. In addition, Alternative B includes specific management actions to enhance or maintain plant communities on large, contiguous blocks of BLM-administered land. Applying a CSU stipulation for discretionary actions to prohibit surface-disturbing and disruptive activities and an NSO restriction within 0.6 mile of occupied greater sage-grouse leks would limit adverse impacts from oil and gas development to greater sage-grouse more than Alternative A. The BLM avoids wind-energy development in areas of greater sage-grouse nesting, brood-rearing, and winter concentration areas and manages areas within 0.6 mile of occupied leks as ROW exclusion areas for discretionary actions under Alternative B. Interim and/or final reclamation of surface disturbance under Alternative B requires 50 percent vegetative cover within three growing seasons and 80 percent cover within 5 years. The BLM requires development of an appropriate reclamation plan before any authorized surface-disturbing activity. Alternative B offers more stringent requirements than Alternative A for the successful establishment of preexisting native habitats. Although surface disturbance results in short-term habitat loss and damage, the reclamation requirements of Alternative B help maintain long-term habitat quality in all habitat types, including sagebrush. Overall, Alternative B would result in the least surface disturbance and habitat loss, degradation, and fragmentation and therefore the least impact to greater sage-grouse habitats.

Alternative B uses wildland fire and other vegetation treatments to restore fire adapted ecosystems in the Planning Area. Establishing a natural fire regime in fire-adapted ecosystems and reducing fuel loads in the Planning Area may lower the risk of catastrophic fire in areas with sufficient native vegetation and precipitation. Since Alternative B relies on natural processes before engaging active restoration, it may not restore fire adapted ecosystems as quickly as the other alternatives.

Alternative B provides greater protection and minimizes impacts to soils, which minimizes to a greater extent the potential adverse impacts associated with the establishment and spread of invasive species, compared with Alternative A. In addition to requiring topsoil salvage and segregation for all surface-disturbing activities, Alternative B requires the reestablishment of healthy native plant communities based on preexisting composition in the area. These actions are anticipated to slow the establishment and spread of invasive species more than Alternative A, resulting in less adverse impacts to greater sage-grouse habitats under Alternative B.

Alternative B excludes ROW development on 132,248 acres in greater sage-grouse Key Habitat Areas (Table 4-9), limiting adverse impacts from transmission lines that can alter and fragment habitat and that may provide perches for predators. Designating all LWCs as Wild Lands and managing them to protect their naturalness, outstanding opportunities for solitude, and primitive and unconfined recreation, would benefit greater sage-grouse by placing resource use and activity restrictions on 200,959 acres in greater sage-grouse Key Habitat Areas (Table 4-9).

Under Alternative B, the BLM restricts livestock grazing more extensively and closes more areas to livestock grazing, including crucial winter range for elk and bighorn sheep and greater sage-grouse Key Habitat Areas. Closing greater sage-grouse Key Habitat Areas may have adverse and beneficial impacts, depending on site-specific range condition. Poor livestock grazing management can have long-term, adverse impacts to greater sage-grouse by degrading habitat (WGFD and BLM 2007). For Key Habitat

Areas in which range conditions are not meeting the *Wyoming Standards for Healthy Rangelands* (Appendix N), closing these areas to livestock grazing may benefit greater sage-grouse by improving habitat conditions over long time periods (40 years or more) (Crawford et al. 2004). Alternative B closes 1,129,179 acres in greater sage-grouse Key Habitat Areas to livestock grazing. However, on Wyoming big sagebrush sites with dense sagebrush and an understory of annual grasses, reductions in livestock grazing may hasten further habitat degradation if ungrazed fuel loads increase the chance of wildfires that kill sagebrush over vast areas (Crawford et al. 2004). Light-to-moderate livestock grazing may improve greater sage-grouse habitat by increasing herbaceous vegetation in arid-to-semiarid areas (Holechek et al. 2006). Appropriate grazing intensity and duration maintains suitable greater sage-grouse habitat (WGFD and BLM 2007). Under all alternatives, livestock grazing management is in accordance with the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* to meet multiple use objectives (e.g., wildlife). Closing greater sage-grouse Key Habitat Areas may create limited long-term beneficial impacts in areas meeting the *Wyoming Standards for Healthy Rangelands*, but may adversely impact other areas by increasing the potential for wildfires in the short term and eliminating the beneficial long-term effect that livestock grazing can have on rangeland vegetation if managed at the appropriate intensity.

Special designations under Alternative B would provide the greatest benefit to greater sage-grouse; designated ACECs encompass 94,399 acres of greater sage-grouse Key Habitat Areas (Table 4-9), restricting resource uses and activities to beneficially impact greater sage-grouse.

Beneficial impacts to greater sage-grouse from proactive management actions would be similar to Alternative A, but to a greater extent. Under Alternative B, the BLM places greater restrictions on oil and gas development in greater sage-grouse habitat and applies larger protective buffers around greater sage-grouse leks. Alternative B closes the most area (1,226,064 acres) to oil and gas development in greater sage-grouse Key Habitat Areas (Table 4-9), greatly reducing adverse impacts from human disturbance that can displace greater sage-grouse (Holloran et al. 2010). Establishing an 0.6-mile protective buffer around greater sage-grouse leks would result in fewer adverse impacts to greater sage-grouse by minimizing individual displacement due to infrastructure, especially oil and gas development (Holloran et al. 2010). Limiting new sources of noise to levels of 10 dBA above ambient noise at the perimeter of leks from 6 PM to 8 AM during initiation of breeding would reduce adverse impacts to greater sage-grouse from noise generation in areas with oil and gas facilities. Overall, proactive management under Alternative B would limit adverse impacts to greater sage-grouse the most, compared to the other alternatives.

Nongame (Raptors)-Alternative B

Surface-disturbing activities, renewable energy development, invasive species control, motorized vehicle use, livestock grazing (Johnson and Horn 2008; Torre et al. 2007; Jones 2000), and management actions for biological resources would adversely impact raptors less under Alternative B than under Alternative A. Compared to Alternative A, restrictions around raptor nests are more extensive under Alternative B and TLS are species-specific, resulting in fewer direct impacts to nesting raptors. Additionally, the BLM applies a seasonal 2-mile buffer to active ferruginous hawk nests and a year-round CSU stipulation to protect all raptor nest sites. Alternative B protects more BLM-administered surface surrounding raptor nests compared to Alternative A, resulting in greater beneficial impacts to special status raptor species. Alternative B is projected to result in fewer acres of surface disturbance and therefore will have less adverse impact on special status raptor terrestrial foraging habitat.

Alternative B would result in the least amount of powerline development, having the least adverse impacts to raptors due to potential electrocution. Wind-energy development is avoided in raptor concentration areas, and approximately 1,251,869 acres are renewable energy exclusion areas under Alternative B, thereby having the least potential to fragment habitats and directly impact raptors from collisions or displacement. The BLM prohibits clear cutting under Alternative B, and uses salvage operations, including appropriate levels of snag retention, to improve wildlife habitat. These actions would result in beneficial impacts by protecting and enhancing more habitat for those raptors that prefer closed canopy habitats, compared to the other alternatives.

Alternative B would continue to improve rangeland productivity and slow the spread of invasive species to a greater extent than Alternative A. Overall, the restrictions to surface-disturbing activities, wind-energy development, and livestock grazing and proactive management to maintain native vegetation under Alternative B would protect more raptor habitats compared to the other alternatives.

Allowing surface-disturbing activities in riparian/wetland areas would adversely impact bald eagles through displacement and habitat loss. Recreational activities would cause impacts similar to those under Alternative A for bald eagles, but to a lesser extent. Maintaining current facilities and not providing campsites at Wardel and Harrington reservoirs would cause fewer adverse impacts to bald eagles by limiting human activity in these areas. Impacts to bald eagles in the Bighorn River SRMA are likely to be less under Alternative B than under Alternative A, because managing the area to provide a "moderate" level of recreation experience would involve less intensive forms of recreation and less human activity.

Closing more acres to livestock grazing under Alternative B (1,988,927 acres) would result in less potential adverse impact to bald eagles from riparian habitat degradation than under Alternative A.

Nongame (Neotropical Migrants)-Alternative B

Under Alternative B, short- and long-term surface disturbance are anticipated to be less; therefore, associated adverse impacts to breeding and nesting habitats for neotropical migrants are anticipated to be less than under Alternative A. The impacts to neotropical migrants from wind-energy development under Alternative B would also be less than under Alternative A.

Sagebrush and Shrubland Species – Alternative B applies the largest buffers around greater sage-grouse leks and in nesting or early brood-rearing habitats to conserve sagebrush habitat (see *Game Birds*). Alternative B would result in the least surface disturbance that may result in habitat loss and has the most stringent requirements for reclamation, which would result in the least impact to neotropical migrants that depend on sagebrush and shrubland habitats.

Grassland Species – Actions in grassland habitat, such as surface-disturbing activities, reclamation, invasive species control, and livestock and wildlife grazing impact special status neotropical migrant species. BLM actions under Alternative B, including designation of the Chapman Bench ACEC, would result in less adverse impact to grassland habitat and would protect more grassland habitat from fragmentation than under Alternative A. Management actions for white-tailed prairie dogs (see *Nongame [Mammals]*) may affect the mountain plover and long-billed curlew, as these species nest in areas with sparse vegetation. Greater restrictions on livestock grazing under Alternative B may result in adverse impacts to mountain plover by reducing available mountain plover habitat (i.e., heavily grazed areas and areas with bare patches); however, managing areas to create preferred habitat for the mountain plover, would likely provide a net benefit to this species.

Riparian/Wetland Species – Although there are no specific management actions for special status neotropical migrants that use riparian areas and wetlands, other biological resource management

actions—particularly those pertaining to water and riparian/wetland areas, such as surface disturbance restrictions, livestock grazing and riparian area management, and special designations—would affect these species. Overall, restrictions on surface disturbance, management of invasive species and livestock grazing, and managing riparian/wetland areas to achieve DPC under Alternative B would protect and enhance more riparian/wetland habitat and benefit special status neotropical migrants in the Planning Area more than under Alternative A.

Nongame (Mammals)-Alternative B

Surface-disturbing activities, invasive species control, fire and fuels management, livestock grazing management, and management actions for biological resources under Alternative B would result in less adverse impacts to special status nongame mammals than under Alternative A.

Sagebrush and Shrubland Species – Sagebrush and shrubland special status nongame mammal species would benefit from management actions limiting habitat fragmentation and surface disturbance in sagebrush and shrubland communities. Measures to protect and reduce potentially adverse impacts to greater sage-grouse, as discussed under *Game Birds*, benefit special status sagebrush and shrubland nongame mammal species. Decreased surface disturbance and less habitat fragmentation under Alternative B would limit adverse impacts to special status nongame mammal species more than Alternative A. In addition, an NSO restriction placed on prairie dog colonies suitable for black-footed ferret reintroduction and the Sage Creek Prairie Dog Town would benefit both species. Alternative B provides the most beneficial impacts to these species compared to other alternatives.

Forest and Woodland Species – Under Alternative B, there are no specific management actions for Canada lynx; however, management actions that protect the habitats Canada lynx and their prey (primarily snowshoe hare) utilize are anticipated to result in beneficial impacts to Canada lynx. Under Alternative B, fewer short-term adverse impacts to Canada lynx would result from forest treatments; however, less stand diversification over the long term may result in less beneficial impacts to Canada lynx habitat and the habitats of its prey species. Prohibiting clear-cutting and precommercial thinning, except for fuels treatments, retains more woody debris than Alternative A to provide cover and den sites and enhance the availability of prey species. Alternative B retains old growth forest areas and, when possible, retains connectivity of existing or potential old growth areas, benefiting Canada lynx more than Alternative A. Alternative B would result in greater short-term beneficial impacts to Canada lynx habitats than Alternative A due to greater restrictions on surface-disturbing activities, but long-term habitat improvement, especially from fire and fuels management to prevent landscape-scale fires, may be limited.

Cave Species – Bats using caves for roosting, maternity colonies, or hibernation may be affected by surface-disturbing activities near caves, cliffs, or other rock features. The BLM closes caves during critical periods for bats and prohibits activities within ¼ mile of AML sites under Alternative B, providing more beneficial impacts than Alternative A. As renewable energy development is excluded in a large area, the potential impacts from wind-energy development to bats are least under Alternative B.

Nongame (Amphibians)-Alternative B

Potential impacts to special status amphibians are correlated with impacts to riparian/wetland habitats. The adverse impacts under Alternative B would be similar to those described for special status neotropical migrants that use riparian/wetland habitats and less than those under Alternative A. Potential adverse impacts to the Great Basin spadefoot toad would be proportional to impacts to sagebrush habitats and are anticipated to be similar to those described for special status neotropical

migrants and greater sage-grouse. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more information on impacts to amphibians.

Alternative C

Surface Disturbance-Alternative C

Under Alternative C, estimated short- and long-term surface disturbance from BLM actions in the Planning Area (Table 4-1) would result in the greatest loss, degradation, and fragmentation of sagebrush habitat compared to the other alternatives. Erosion from surface disturbance would cause the greatest impact to riparian/wetland habitats under Alternative C. Surface disturbance from roads totals 4,638 acres in the short term and 2,319 acres in the long term under Alternative C, potentially forming the most barriers to fragment habitat (Appendix T).

Resource Uses-Alternative C

Minerals development under Alternative C would result in similar adverse impacts to special status species as under Alternative A, but to a greater extent. Alternative C has the most acres open to mineral development, resulting in the greatest potential loss of special status wildlife species habitat, compared to the other alternatives. Alternative C is projected to result in 1,257 new federal oil and gas wells that would result in more adverse impacts from habitat loss and noise disturbance than Alternative A.

Alternative C would have the most powerline development, resulting in the greatest potential risk for raptor electrocution. The BLM closes a limited portion of the Planning Area to wind-energy development, and allows projects in special status raptor species and greater sage-grouse habitat on a case-by-case basis. The projected impact of wind-energy development to special status wildlife species would be less than Alternative A, but more than alternatives B and D.

Alternative C closes the least amount of land to motorized vehicle use and does not close threatened and endangered species habitat to this resource use. Alternative C is likely to result in the greatest disturbance of special status wildlife species from motorized vehicle use.

The BLM allows livestock grazing in the same areas under Alternative C as under Alternative A, but manages to optimize commodity production while meeting rangeland health standards, not to provide for the enhancement of other resource values. Livestock grazing is restricted the least under this alternative and is more likely to concentrate in riparian/wetland areas, causing the greatest impact to riparian/wetland special status wildlife species. Wild horse grazing in HMAs would also have similar adverse effects to Alternative A, as horses also congregate near water, adversely affecting riparian/wetland special status wildlife species.

Special Designations-Alternative C

Only two ACECs are designated under Alternative C and this alternative does not recommend any WSR eligible waterway segments as suitable for inclusion in the NWSRS and releases these waterways to other resource uses, resulting in no beneficial impacts to special status wildlife species.

Resources-Alternative C

Under Alternative C, the BLM uses wildland fire to restore fire-adapted ecosystems and reduce hazardous fuels, but also to enhance forage for commodity production, potentially benefitting special status wildlife species less than the other alternatives when restoration objectives conflict. However, treatments are used across the Planning Area to restore vegetative diversity and reduce the risk of

unnatural fire, providing the greatest potential benefit to special status wildlife species from fire and fuels management.

In general, Alternative C allows for the greatest expansion of resource uses, and therefore would result in the greatest spread of invasive species, relative to the other alternatives. The impacts to special status wildlife species from invasive species would be the greatest under Alternative C.

Forest management under Alternative C is similar to Alternative A, but timber harvesting is performed with economic objectives as the primary concern with less regard for wildlife habitat values. The BLM allows larger clear cut areas with the associated adverse impacts described under Alternative A, but old growth forests are retained under Alternative C, directly benefitting Canada lynx and special status raptor and bat species. Although the impacts from forest management actions vary, in general, forest management under Alternative C would provide some beneficial impacts to special status wildlife species from old growth stand retention, but would also result in the greatest adverse impacts to special status wildlife species from timber harvest practices with less regard for wildlife habitat values.

Grassland and shrubland management under Alternative C would provide more beneficial impacts to special status wildlife species than Alternative A, but less than alternatives B and D. Under Alternative C, the BLM manages grassland and shrubland communities toward meeting the *Wyoming Standards for Healthy Rangelands* (Appendix N) with appropriate functional and structural plant groups. These measures are likely to result in a modest improvement in vegetation diversity, but are unlikely to slow the spread of invasive species. Reclamation requirements are more stringent than Alternative A, but less than alternatives B and D. Due to the larger amount of anticipated surface disturbance and invasive species spread under Alternative C, grassland and shrubland communities are likely to be lost or degraded the most under this alternative, affecting special status wildlife species proportionately.

Alternative C provides riparian/wetland communities the least protection compared to other alternatives. The BLM manages all riparian/wetland areas toward meeting PFC, but only prioritizes those in a nonfunctioning condition or with a downward trend. Alternative C is likely to result in the greatest amount of degraded riparian/wetland habitat.

Proactive Management-Alternative C

In general, proactive management under Alternative C provides fewer benefits and mitigates adverse impacts to special status wildlife species to a lesser extent than alternatives A, B, and D. Impacts due to proactive management, and other impacts, are described in detail under each special status wildlife species category below.

Trophy Game-Alternative C

Alternative C has the fewest seasonal closures and restrictions of big game winter ranges and migration corridors and the greatest potential for habitat fragmentation and disturbance to wildlife by exempting Oil and Gas Management Areas and ROW corridors from seasonal wildlife stipulations. Adverse impacts from livestock grazing under Alternative C would be similar to those under Alternative A, but to a greater extent from allowing domestic sheep grazing in more areas. Overall, adverse impacts to the grizzly bear are anticipated to be the greatest under Alternative C.

Predatory Animals-Alternative C

Under Alternative C, there are no specific management actions for gray wolves; however, management actions that protect the habitats gray wolves and their prey (primarily elk) utilize would benefit gray wolves in the Planning Area. Management actions limiting human activities, ROW development such as

roads, and habitat fragmentation also would benefit gray wolves. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more detail on impacts to big game.

Allowing the most timber harvesting (e.g., clear cutting up to 100 acres), mechanical fuels treatments, and prescribed burns under Alternative C would result in the greatest short-term adverse impacts to gray wolves from disturbance and displacement and less long-term beneficial impacts than under Alternative A from timber harvesting that does not protect habitat values. Additionally, allowing timber management roads to remain open for recreational use would adversely impact gray wolves by allowing more human access and potential disturbance, illegal hunting, and habitat fragmentation.

Under Alternative C, seasonal buffers prohibiting surface disturbance around active raptor nests are smaller in size than under alternatives A, B, and D. Alternative C results in the greatest amount of road development (2,319 acres) causing greater habitat fragmentation and risk of vehicle collisions than the other alternatives (Appendix T). Alternative C implements the same seasonal restrictions on big game crucial winter range with regards to surface disturbance, but exempts Oil and Gas Management Areas and ROW corridors and opens the Absaroka Front Management Area to mineral, renewable energy, and ROW developments, and motorized vehicle use. Based on more surface disturbance, more potential habitat fragmentation from roads, and a larger area open to cross-country motorized travel, Alternative C results in the fewest beneficial impacts to gray wolves, compared to the other alternatives.

Game Birds (Greater Sage-grouse)-Alternative C

Estimated short- and long-term surface disturbance from BLM actions under Alternative C are greater than alternatives A, B, and D (Table 4-1), resulting in the greatest potential for loss, degradation, and fragmentation of sagebrush habitats. Alternative C does not include specific management actions for management of large, contiguous blocks of BLM-administered land by enhancing or maintaining plant communities. Similar to Alternative A, the BLM allows wind-energy projects on a case-by-case basis under Alternative C, but manages some areas as renewable energy exclusion areas (151,506 acres), which may result in less adverse impacts than under Alternative A.

Alternative C requires 30 percent desired vegetative cover within three growing seasons, but has no other specific reclamation requirements of disturbed areas; however, the BLM requires reclamation plans on a case-by-case basis, placing more emphasis on reclamation than Alternative A, but not as much as alternatives B and D. Overall, because surface disturbance and habitat loss, degradation, and fragmentation are greater than under the other alternatives and the reclamation requirements are comparable to Alternative A and less than alternatives B and D, the associated adverse impacts to greater sage-grouse habitats from these activities would be the greatest under Alternative C.

Alternative C uses wildland fire and treatments to restore fire adapted ecosystems in the Planning Area. Establishing the natural fire regime in fire-adapted ecosystems and reducing fuel loads in the Planning Area may reduce the potential for more intense fires that can destroy sagebrush habitat. Due to the large area treated with prescribed fire (80,000 acres), the long-term benefits to the greater sage-grouse from fire and fuels management under Alternative C are greater than under alternatives A, B, and D.

In general, Alternative C has the same requirements as Alternative A to establish vegetative cover in disturbed areas, but does not require the reestablishment of native plant communities; the BLM reestablishes plant communities to increase commodity production to meet other resource objectives. Alternative C, because it has the most projected surface disturbance and does not require native vegetation reestablishment, has the greatest potential adverse impacts to greater sage-grouse habitat due to the continued establishment and spread of invasive species.

Alternative C opens the Planning Area to livestock grazing similarly to Alternative A, but the BLM manages livestock grazing to optimize commodity production while meeting rangeland health standards, not to provide for the enhancement of other resources. Livestock grazing is also subject to less stringent monitoring under Alternative C. As livestock grazing can adversely affect greater sage-grouse habitat if intensity and timing are not properly managed, Alternative C results in the greatest adverse impacts to the greater sage-grouse in this regard. The effects of wild horse grazing in HMAs would be similar to those under Alternative A.

Special designations under Alternative C would provide less beneficial impacts to greater sage-grouse than the other alternatives. ACECs designated under this alternative encompass the least area of greater sage-grouse Key Habitat Areas (Table 4-9).

Proactive management actions under Alternative C would limit adverse impacts to greater sage-grouse similarly to those under Alternative A, but to a lesser extent. Under Alternative C, the BLM places similar restrictions on oil and gas development in greater sage-grouse habitat and applies protective buffers around greater sage-grouse leks, but exempts Oil and Gas Management Areas and ROW corridors from discretionary wildlife seasonal stipulations. Exempting Oil and Gas Management areas from seasonal stipulations would result in adverse impacts to approximately 35 greater sage-grouse leks in these areas. Limiting noise sources to 10 dBA above natural, ambient noise during the greater sage-grouse breeding season would result in impacts similar to those under Alternative B, but to a lesser extent. Overall, proactive management actions under Alternative C would limit adverse impacts to the greater sage-grouse less than the other alternatives.

Nongame (Raptors)-Alternative C

Surface-disturbing activities, fire and fuels management, invasive species control, motorized vehicle use, livestock grazing (Johnson and Horn 2008; Torre et al. 2007; Jones 2000), and management actions for biological resources would impact special status raptors more under Alternative C than under alternatives A, B, or D. Under Alternative C, restrictions around raptor nests (53,336 acres) are less extensive than the other alternatives. Though TLS are species specific as under Alternative B, the reduced buffer distance is likely to result in the greatest disturbance to raptor nests under Alternative C. Alternative C is projected to result in more surface disturbance than the other alternatives and, therefore, will have a greater adverse impact on bald eagle terrestrial foraging habitat.

The BLM projects the most powerline development under Alternative C, resulting in the greatest potential adverse impact to raptors from electrocution. The BLM allows wind-energy development in raptor concentration areas on a case-by-case basis, which may result in greater adverse impacts to raptors than alternatives B and D, but less than Alternative A. The BLM allows clear cuts up to 100 acres under this alternative, which would result in a greater adverse impact to raptors that prefer closed canopy habitat than under Alternative A. Forest salvage operations are performed where economically feasible without an appropriate level of snag retention, potentially adversely affecting raptors by degrading habitat; however, because Alternative C retains old growth forests, greater beneficial impacts would result under this alternative than under Alternative A.

Management actions for invasive species control under Alternative C would result in similar special status raptor habitat quality impacts as under Alternative A. Management actions for fire management under Alternative C may, more than the other alternatives in the long term, reduce the potential for catastrophic fire that would adversely impact special status raptor species habitat. Based on these actions, Alternative C would result in greater adverse impacts to special status raptor species habitats than the other alternatives.

Alternative C is anticipated to improve rangeland productivity primarily for livestock grazing, with less area closed to livestock grazing and less forage available for wildlife. Livestock grazing has been shown to reduce raptor prey in arid ecosystems and grasslands (Johnson and Horn 2008; Torre et al. 2007; Jones 2000). Livestock grazing management under Alternative C would result in similar adverse impacts to those under Alternative A, but to a greater extent.

Impacts from recreational use to bald eagles under Alternative C would be similar to Alternative A, but to a lesser extent. Managing lands along the Bighorn River for wildlife habitat, river health, and wildlife resources with less emphasis on recreation would result in fewer adverse impacts to bald eagles from human activity.

Nongame (Neotropical Migrants)-Alternative C

Under Alternative C, short- and long-term surface disturbance would be the greatest, resulting in the greatest adverse impacts to breeding and nesting habitats for special status neotropical migrants, compared to the other alternatives. The impacts from wind-energy development under Alternative C are likely to be similar to Alternative A, as projected development is the same across all alternatives and Alternative C manages the least acreage (151,506 acres) as renewable energy exclusion areas, compared to alternatives B and D.

Sagebrush and Shrubland Species – Measures that adversely affect the greater sage-grouse under Alternative C, as discussed under *Game Birds*, would result in similar impacts to other sagebrush and shrubland species. Alternative C would result in the greatest adverse impacts to these species.

Grassland Species – Actions such as surface-disturbing activities, reclamation, invasive species control, and wild horse and livestock grazing in grassland habitats would affect grassland special status neotropical migrant species. Alternative C would result in more fragmentation of grassland habitat compared to the other alternatives. Protective measures for the mountain plover are similar to Alternative B, but the larger amount of surface disturbance, especially the disturbance allowed in all prairie dog towns, may result in the greatest adverse impacts to nesting habitat for this species and the long-billed curlew. However, fewer restrictions on livestock grazing and measures to manage for areas of sparse vegetation under Alternative C may benefit mountain plover by increasing its habitat.

Riparian/Wetland Species – Although no specific management actions for special status neotropical migrants utilizing riparian/wetland areas are identified under Alternative C, other biological resource management actions, particularly those pertaining to water and riparian/wetland habitats, would affect these species. Under Alternative C, actively managing less area for riparian habitat enhancement, allowing surface-disturbing activities in riparian/wetland areas on a case-by-case basis, and allowing the placement of forage supplements to maximize livestock use, regardless of proximity to riparian/wetland areas would result in the most adverse impacts to special status neotropical migrants that prefer these habitats.

Nongame (Mammals)-Alternative C

Surface-disturbing activities, invasive species control, fire and fuels management, livestock grazing management, and management actions for biological resources would impact special status nongame mammals. Long-term surface disturbance under Alternative C is the greatest compared to all alternatives, likely resulting in proportional adverse impacts to these species.

Sagebrush and Shrubland Species – Measures that adversely affect the greater sage-grouse under Alternative C, as discussed under *Game Birds*, would result in similar impacts to special status nongame mammals in sagebrush and shrubland communities. Alternative C would result in the greatest adverse impacts to sagebrush and shrubland nongame mammals from surface disturbance and livestock grazing

and has the fewest measures to mitigate the adverse impacts of surface-disturbing activities to prairie dogs and the associated mountain plover habitat. Although more active fuels treatments to prevent large wildfires may provide a long-term benefit to sagebrush and shrubland nongame mammals, the amount of habitat destroyed from long-term surface disturbance is likely to outweigh this benefit.

Forest and Woodland Species – Under Alternative C, there are no specific management actions for Canada lynx; however, management actions that protect the habitats Canada lynx and their prey (primarily snowshoe hare) utilize would result in beneficial impacts to Canada lynx. Under Alternative C, short-term impacts from silviculture and fuels treatments may temporarily result in adverse impacts to Canada lynx; however, over the long term these treatments may improve Canada lynx habitat and the habitats of its prey species. Precommercial thinning and clear-cutting up to 100 acres would retain less woody debris than Alternative A, resulting in similar adverse impacts, but to a greater extent. However, retaining old growth forests and adopting connectivity of these areas where feasible would result in similar beneficial impacts to those under Alternative B. Smaller buffer areas around raptor nests and allowing surface-disturbing activities in riparian/wetland areas would result in more adverse impacts to Canada lynx from habitat destruction and potential disturbance. Overall, Alternative C would result in more adverse impacts to Canada lynx habitats than Alternative A due to less restrictions on surface-disturbing activities and more intensive timber harvesting methods.

Cave Species – Surface-disturbing activities near caves, cliffs, or other rock features may impact bats using caves for roosting, maternity colonies, or hibernation. Alternative C manages caves for recreational use, allows activities in AML areas, and does not close caves during critical periods for bats, resulting in the greatest potential adverse impact to bat species. Impacts to bats from wind-energy development under Alternative C would be similar to those under Alternative A.

Nongame (Amphibians)-Alternative C

Potential impacts to special status amphibian species would be correlated with impacts to riparian/wetland habitats. The adverse impacts under Alternative C are similar to those described for special status neotropical migrants that use riparian/wetland habitats and greater than under alternatives A, B, and D. Potential adverse impacts to the Great Basin spadefoot toad are correlated with impacts to sagebrush habitats and are anticipated to be similar to those described for special status neotropical migrants and greater sage-grouse; these impacts would be greater under Alternative C than under the other alternatives. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more information on impacts to amphibians.

Alternative D

Surface Disturbance-Alternative D

Estimated short- and long-term surface disturbance from BLM actions in the Planning Area (Table 4-1) under Alternative D would result in similar loss, degradation, and fragmentation of sagebrush habitat as under Alternative A. However, measures to limit erosion and reclaim and restore habitat implemented under Alternative D are likely to mitigate adverse impacts from surface disturbance more than under Alternative A.

Resource Uses-Alternative D

Minerals development under Alternative D would result in similar adverse impacts to special status wildlife species as under Alternative A, but to a lesser extent. Alternative D has the second most area open to locatable minerals development, but the second least area open to oil and gas development, with more area closed than alternatives A and C in sagebrush habitat to limit impacts to greater sage-

grouse. Alternative D is projected to result in 1,032 new federal wells that would impact special status wildlife species from habitat loss and noise disturbance more than Alternative B, but less than alternatives A and C.

The BLM projects that Alternative D would result in the same amount of powerline development as Alternative A with similar potential adverse impacts to raptors. Alternative D manages the greatest area as renewable energy avoidance/mitigation areas, and the second-most area as renewable energy exclusion areas. Impacts from ROW and wind-energy development under Alternative D would result in more adverse impacts to special status wildlife species than under Alternative B, but less than under alternatives A and C.

Alternative D closes a similar amount of acreage as Alternative A to motorized vehicle use, and limits motorized vehicle use to designated roads and trails in the second-largest area, including essential and recovery habitat for threatened and endangered species. Adverse impacts from motorized vehicle use under Alternative D would be greater than under Alternative B, but less than under alternatives A and C.

Livestock grazing management under Alternative D would result in impacts similar to those under Alternative A. However, livestock grazing management under Alternative D may provide some benefits because the BLM uses livestock grazing management in certain areas, such as special status wildlife species habitat, to maintain or improve resource conditions.

Special Designations-Alternative D

Special designations under Alternative D would result in similar beneficial impacts as those under Alternative B, but to a lesser extent. Alternative D designates less area as ACECs, does not recommend any WSR eligible waterway segments as suitable for inclusion in the NWSRS and implements fewer restrictions on resource uses and activities to protect special status wildlife species habitat in these areas.

Resources-Alternative D

Impacts to special status wildlife species from fire and fuels management and forests, woodlands, and forest products management under Alternative D would be similar to those under Alternative A, except that by allowing larger areas to be clear cut under Alternative D, there would be more habitat loss for special status wildlife species that prefer closed canopies, such as certain raptors and Canada lynx. However, Alternative D includes management actions to retain old-growth forests that would benefit these species more than Alternative A.

Beneficial impacts to special status wildlife species from grassland and shrubland community management under Alternative D would be similar to those under Alternative B, although to a lesser extent. The BLM manages to achieve or make progress toward achieving 65 percent – instead of 75 percent under Alternative B – or more of Historical Climax Plant Community under Alternative D, resulting in less beneficial impacts to special status wildlife species habitat than Alternative B. However, Alternative D would treat more area for invasive species than Alternative B, providing greater long-term beneficial impact by preventing the spread of invasive species that may degrade special status wildlife species habitat. Livestock flushing practices would result in impacts to grassland and shrubland communities similar to those under Alternative A.

The management of riparian/wetland resources under Alternative D would result in similar beneficial impacts as those under Alternative C, but to a greater extent. Habitat would improve, but additional management would be necessary to ensure that habitat meets life history requirements for various special status wildlife species. Alternative D applies more restrictions to surface-disturbing activities near riparian/wetland areas than Alternative C, limiting adverse impacts from surface disturbance.

Overall, beneficial impacts to riparian/wetland habitat for special status wildlife species under Alternative D would be greater than under alternatives A and C, but less than under Alternative B.

Proactive Management-Alternative D

In general, proactive management actions under Alternative D provide more benefits and mitigate adverse impacts to special status wildlife species to a greater extent than under alternatives A and C, but less than under Alternative B. Impacts due to proactive management and other impacts are described in detail under each special status wildlife species category below.

Trophy Game-Alternative D

Alternative D exempts Oil and Gas Management Areas from discretionary big game seasonal stipulations, but applies more restrictions and seasonal closures in big game habitat, around active raptor nests, and in greater sage-grouse Key Habitat Areas than alternatives A and C that would limit adverse impacts to grizzly bear. Impacts from livestock grazing management on grizzly bear under Alternative D would be similar to those under Alternative A.

Predatory Animals-Alternative D

Under Alternative D, there are no specific management actions for gray wolves; however, management actions that protect the habitats gray wolves and their prey (primarily elk) utilize would benefit gray wolves in the Planning Area. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more detail on impacts to big game. Management actions limiting human activities, ROW development such as roads, and habitat fragmentation under Alternative D would benefit gray wolves more than under alternatives A and C, but less than under Alternative B. Forests and woodlands management under Alternative D would result in impacts to gray wolves similar to those under Alternative A. Habitat enhancement in sagebrush and aspen habitats under Alternative D would result in limited beneficial impacts to gray wolves, similar to Alternative C.

Game Birds (Greater Sage-grouse)-Alternative D

Estimated short- and long-term surface disturbance from BLM actions under Alternative D are similar to Alternative A, with greater restrictions on oil and gas development in sagebrush habitat (Table 4-8) and more area closed to oil and gas development in greater sage-grouse Key Habitat Areas (Table 4-9). Alternative D manages the most area as wind-energy avoidance/mitigation areas and the second-most area as wind-energy exclusion areas limiting adverse impacts to greater sage-grouse to a greater extent than alternatives A and C, but to a lesser extent than Alternative B.

Reclamation practices under Alternative D that mitigate impacts to greater sage-grouse habitat from surface disturbance are similar to those under Alternative A, but would result in greater beneficial impacts from reestablishing native or DPCs based on pre-disturbance or desired species composition, requiring temporary surface treatments to facilitate reclamation of disturbed areas, and considering reclamation achieved only if conditions are equal to or better than pre-disturbance conditions.

Fire and fuels management under Alternative D would result in impacts similar to those under Alternative A. Livestock grazing management also would result in impacts similar to Alternative A, although there may be more beneficial impacts to greater sage-grouse from allowing livestock grazing, even in closed areas, to improve greater sage-grouse habitat condition (WGFD and BLM 2007 and Holechek et al. 2006). The effects of wild horse grazing in HMAs would be similar to those under Alternative A.

Special designations under Alternative D would protect the second-most area in greater sage-grouse Key Habitat Areas, providing more beneficial impacts to greater sage-grouse than alternatives A and C, but less than Alternative B.

Overall, proactive management under Alternative D would minimize adverse impacts to the greater sage-grouse more than under alternatives A and C, but less than under Alternative B. Proactive management actions to restrict resource uses and activities in greater sage-grouse habitat would minimize adverse impacts similarly to Alternative B, although to a lesser extent. Key Habitat Areas are open to mineral leasing under Alternative D with restrictive buffers around occupied and undetermined leks. Overall, resource use and activity restrictions under Alternative D would minimize impacts to greater sage-grouse in Key Habitat Areas more than alternatives A and C, but less than Alternative B. Outside of Key Habitat Areas, restrictions on resource uses and activities would result in similar beneficial impacts as under Alternative B, although to a lesser extent. The BLM implements proactive management actions to both occupied and undetermined leks, although resource use and activity restrictions, and the extent to which they are applied, are generally greater under Alternative B than under Alternative D. The BLM maintains the goal of consolidating anthropogenic features on the landscape to minimize greater sage-grouse habitat fragmentation under Alternative D, but does not implement it with a CSU stipulation, as under Alternative B.

Nongame (Raptors)-Alternative D

Surface-disturbing activities, fire and fuels management, invasive species spread, and livestock grazing (Johnson and Horn 2008; Torre et al. 2007; Jones 2000) under Alternative D would impact special status raptors more than under Alternative B, but less than under alternatives A and C. Seasonal restrictions on surface-disturbing activities around active raptor nests are species-specific in timing and more extensive than Alternative C. Alternative D also applies a year-round CSU stipulation with similar beneficial impacts as under Alternative B. Alternative D is projected to result in more surface disturbance than alternatives A and B, with impacts to special status raptor terrestrial foraging habitat similar to Alternative A.

Powerline and wind-energy development under Alternative D would result in similar adverse impacts to those under Alternative A, although to a greater extent, as Alternative D manages more land as ROW exclusion or avoidance/mitigation areas.

Impacts to raptor terrestrial foraging areas from surface disturbance, fire and fuels management, invasive species control, and livestock grazing would be similar to impacts under Alternative A. Vegetation management in these habitats (i.e., managing toward 65 percent or more of Historical Climax Plant Community) would result in more beneficial impacts than alternatives A and C, but less than Alternative B.

Riparian/wetland resources management and restrictions on surface-disturbing activities in these areas under Alternative D would result in less adverse impacts to bald eagles than under alternatives A and C, but greater than under Alternative B. Recreational development at Wardel and Harrington reservoirs under Alternative D result in impacts similar to those under Alternative A. Impacts from recreational use in the Bighorn River area would be similar to those under Alternative B, although to a lesser extent because under Alternative D, the BLM would manage the Bighorn River ERMA in the CYFO for resource protection, among other objectives, with less emphasis on recreation.

Nongame (Neotropical Migrants)-Alternative D

Projected short- and long-term surface disturbance under Alternative D would result in similar adverse impacts to neotropical migrants as those under Alternative A. Impacts to neotropical migrants from wind-energy development would be greater than Alternative B, but less than alternatives A and C.

Sagebrush and Shrubland Species – Measures to protect and reduce potentially adverse impacts to greater sage-grouse, as discussed under *Game Birds*, benefit special status sagebrush and shrubland species. In general, Alternative D places the second-most restrictions on mineral development in sagebrush habitat and has the second-most stringent requirements for reclamation, resulting in the second-least adverse impact to neotropical migrants that depend on sagebrush and shrubland habitats.

Grassland Species – Management actions to limit habitat fragmentation in grasslands under Alternative D would result in impacts similar to those under Alternative B. Management actions for white-tailed prairie dogs (see *Nongame [Mammals]*) may affect the mountain plover and long-billed curlew. Livestock grazing management would result in impacts similar in extent to those under Alternative A but with similar benefits to alternatives B and C from managing grazing in certain areas to create mountain plover habitat. Restrictions on surface-disturbing activities and mineral development in the Chapman Bench Management Area would result in similar beneficial impacts to those under Alternative B, but to a lesser extent.

Riparian/Wetland Species – Biological resource management actions pertaining to water and riparian/wetland habitats would affect special status neotropical migrant species in these areas. Impacts from riparian/wetland resources management under Alternative D would be similar to those under Alternative C. Under Alternative D, impacts from surface-disturbing activities and livestock grazing would be less than under Alternative C, but similar to Alternative A.

Nongame (Mammals)-Alternative D

Surface-disturbing activities, invasive species control, fire and fuels management, livestock grazing management, and management actions for biological resources would impact special status nongame mammals. Long-term surface disturbance under Alternative D would result in similar adverse impacts as those under Alternative A.

Sagebrush and Shrubland Species – Measures that adversely affect the greater sage-grouse under Alternative C, as discussed under *Game Birds*, would have similar impacts to special status nongame mammals in sagebrush and shrubland communities. Minerals development under Alternative D, based on restrictions applied in sagebrush habitat (Table 4-8) would result in more adverse impacts than under Alternative B, but less than under alternatives A and C. Fire and fuels management under Alternative D would result in impacts similar to those under Alternative A. Conservation measures, terms and conditions, and BMPs would minimize impacts to prairie dogs similarly to Alternative A. Measures to limit habitat fragmentation and NSO restrictions on prairie dog colonies suitable for black-footed ferret reintroduction would limit adverse impacts to these species similarly to Alternative B.

Forest and Woodland Species – Under Alternative D, there are no specific management actions for Canada lynx; however, restrictions on surface-disturbing activities around active raptor nests would result in greater beneficial impacts than under alternatives A and C, due to a year-round CSU stipulation, but less than under Alternative B. Silviculture treatments and fire and fuels management practices under Alternative D would result in similar adverse impacts to those under Alternative A, but to a greater extent by allowing larger clear cuts and precommercial thinning. However, Alternative D does retain old growth forests, which would benefit Canada lynx similarly to alternatives B and C.

Cave Species – Alternative D closes caves during critical bat periods and allows activities in AML areas if the impacts can be avoided or mitigated, limiting adverse impacts to special status bat species similarly to Alternative B, but to a lesser degree.

Nongame (Amphibians)-Alternative D

Potential impacts to special status amphibians are correlated with impacts to riparian/wetland habitats. Adverse impacts under Alternative D would be less than those under alternatives A and C, but more than those under Alternative B. Impacts to the Great Basin spadefoot toad are proportional to impacts to sagebrush habitat, which would be less than those under alternatives A and C, but more than those under Alternative B. See Section 4.4.6 *Fish and Wildlife Resources - Wildlife* for more information on impacts to amphibians.

4.4.10 Wild Horses

Wild horses are managed for self-sustaining populations of healthy, free-roaming animals in balance with other uses and the productive capacity of their habitat. Management of wild horses is performed consistent with the Wild Free Roaming Horses and Burros Act of 1971, multiple use objectives in the FLPMA, and conformance with the *Wyoming Standards for Healthy Rangelands* (Appendix N), and in compliance with relevant court orders and agreements, including the Consent Decree (August 2003).

Adverse impacts to wild horses include management that reduces vegetation for forage, the availability of water, or other habitat components necessary to maintain the health of horses and the initial appropriate management level in HMAs. Beneficial impacts to wild horses result from management that increases the health, forage, genetic variability, and movement of wild horses in HMAs.

Direct impacts to wild horses result from management that affects their health, forage, and free-roaming nature. Actions that alter wild horse habitat in HMAs, such as surface disturbance that reduces forage in the short term, would result in direct impacts. Indirect impacts to wild horses may result from the construction of fences and activities that increase the competition for resources among wild horses, livestock, and wildlife in the long term, such as increased resource uses and land tenure adjustments or other management actions that subsequently alter the health, forage, and free-roaming character of wild horses.

4.4.10.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- The number of wild horses would increase by about 18 percent annually and be maintained by periodic removals.
- Wild horse removals (gathers) would occur about every 3 to 5 years in each HMA.
- Maintenance of wild horse populations at initial appropriate management levels in existing HMAs would be accomplished through removals and selected application of other population control practices.
- Wild horse gathers would use existing trap locations for the most part.
- Conducting wild horse gathers in the fall, when temperatures are lower, would reduce stress on the animals; however, summer gathers scheduled during the cooler morning hours would also limit such stress.

4.4.10.2 Summary of Impacts by Alternative

Adverse impacts to wild horses primarily result from management that reduces the forage, health, and free-roaming nature of wild horses. The expansion of the McCullough Peaks HMA under alternatives B and D, would result in beneficial impacts to wild horses by adjusting the HMA boundary to more accurately correspond to the range the resident herd uses, rather than continued attempts to recapture and move horses. Alternatives B and, to a lesser extent, Alternative D implement proactive management and constrain resource uses and disruptions (e.g., restrictions on organized special recreation permits [SRPs] in HMAs) in ways beneficial to wild horse forage and health. Alternatives A and C would result in similar impacts to wild horses, with the implementation of Alternative C causing more adverse impacts to wild horses than Alternative A, especially in the short term. Under all alternatives, wild horse populations may be brought into balance with available habitat and resources needed to sustain genetically viable herds.

4.4.10.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

The types of potential impacts to wild horses under the various alternatives are similar. However, the extent and intensity of impacts would vary by alternative. Therefore, discussions for individual alternatives describe impacts to wild horses from surface-disturbing activities, minerals development, ROW development, motorized vehicle use, recreation, livestock grazing, special designations, fire and fuels management, and proactive management actions.

Managing HMAs to be consistent with the *Wyoming Standards for Healthy Rangelands* (Appendix N) results in adverse and beneficial long-term impacts to wild horses. Fencing to improve livestock grazing distribution would affect the movement of wild horses and would affect their overall free-roaming nature. Water developments may improve the distribution of wild horses in each HMA. Conformance with the *Wyoming Standards for Healthy Rangelands* in upland areas would result in improved plant vigor, production, and diversity of species available as forage, which would result in beneficial impacts to wild horses.

Increased incidence of drought and associated increases in wildfire and reductions in the availability of water from climate change may result in long-term adverse impacts to wild horses. See the climate change section at the end of this chapter for more information regarding potential impacts from climate change.

Management that decreases adverse impacts to water quality, watersheds, and soils, such as avoiding or prohibiting surface disturbance near water or on slopes, maintaining watershed improvement projects, and using BMPs to reduce runoff, soil erosion, and sediment yield to retain water on landscapes would result in long-term benefits to wild horses. Management of resources that enhance habitat and forage production would contribute to habitat health and the overall health of horses.

Under all alternatives, the following Herd Areas would not be managed for wild horses: Sand Draw (13,743 acres), Zimmerman Springs (11,518 acres), Alkali Spring Creek (2,584 acres), Foster Gulch (134,222 acres), and North Shoshone (19,233 acres). Analysis for the previous RMPs determined that managing wild horses in these Herd Areas resulted in management issues or conflicts that were most appropriately resolved by the removal of wild horses. These decisions and findings remain valid because the resource conditions have not changed; therefore, the continued exclusion of wild horses from these areas results in beneficial impacts to wild horse management.

Managing the initial appropriate management level of wild horses in the Fifteenmile HMA (70 to 160 breeding adults) and the McCullough Peaks HMA (70 to 140 breeding adults) to be adjusted as necessary based upon monitoring would result in beneficial long-term impacts to wild horses from maintaining genetic viability in the HMAs. Allowing free movement of herds in HMAs would further increase the genetic viability of wild horse populations in HMAs. Employing selective removal criteria in accordance with current national policies during periodic gathers to increase the prevalence of desired genetic characteristics and avoid genetic depression would result in long-term benefits to wild horses by increasing long-term health and genetic viability.

Considering the use of natural and artificial population control measures, as needed, to maintain the populations of wild horses in the initial appropriate management levels may result in long-term beneficial impacts to wild horses by improving health of populations and facilitating effective strategies for managing wild horses and their habitat.

Basing future adjustments to appropriate management levels in the HMAs on monitoring and multiple use considerations through development of and/or revisions to HMA Plans would result in long-term beneficial impacts to wild horses by providing an appropriate review of herd objectives and conditions before forage allocations are made.

The use of certified weed-free forage supplements would result in beneficial impacts to wild horses by decreasing the potential for invasive species establishment and spread that would compete with native vegetation and lead to losses in forage. The use of forage supplements would also reduce competition for food sources in times of drought between wild horses and other wildlife.

Maintaining up-to-date Herd Gathering Plans and emphasizing the gathering of wild horses that move outside HMAs or onto private lands would result in overall beneficial impacts to management of the wild horses program within the context of multiple use. A strategic and reasoned approach to gathering wild horses would result in more effective and efficient gathering activities. Gathering excess wild horses would also result in reduced competition for resources (e.g., forage, water, and habitat) which may increase the health and viability of the horses remaining within the initial appropriate management level.

Special designations may result in beneficial impacts to wild horses by limiting impacts to resources (e.g., soil, water, and vegetation) that would affect wild horses. Under all alternatives, HMAs overlap with WSAs. Managed to be consistent with the IMP, activities that would adversely impact resource uses may be limited or prohibited in WSAs. These limitations would result in beneficial impacts to wild horses in the HMAs, except that new water development or other projects to benefit wild horses would likely be precluded from construction in WSAs.

Alternative A

Surface Disturbance

Surface disturbance affects wild horses both directly and indirectly. The severity of impacts to wild horses from surface disturbance depends on the location of the surface disturbance. Disturbance in HMAs would more directly affect wild horses. The location of surface disturbance projected in Appendix T has not been determined. However, land use allocations under each alternative may affect the location of surface disturbance. Land use allocations by alternative in each HMA are summarized in Table 4-10.

Table 4-10. Land Use Allocations (acres) within Herd Management Areas by Alternative

Management		McCullough Peaks HMA				Fifteenmile HMA			
		Alternative A	Alternative B	Alternative C	Alternative D	Alternative A	Alternative B	Alternative C	Alternative D
Total Acreage in HMA		103,863	113,938	103,863	113,938	70,524	70,524	70,524	70,524
Travel Management Designation	Open/Play Area	0	0	0	0	0	0	0	0
	Limited to Designated Roads and Trails	48,487	113,937	103,680	58,422	0	54,576	16,604	54,576
	Limited to Existing Roads and Trails	55,376	1	183	55,516	54,704	0	54,576	127
	Closed	0	0	0	0	15,820	15,948	0	15,820
	Seasonal Restriction	0	0	0	0	0	0	0	0
ROW	Avoidance/ Mitigation	26,776	107,778	62,483	90,231	18,157	69,517	27,445	70,399
	Exclusion	2,733	6,160	0	0	4,507	1,007	0	0
	Open	74,375	0	41,380	23,707	47,860	0	43,079	125
Livestock Grazing	Closed	22	60,361	22	22	0	34,603	0	0
	Open	103,841	55,731	103,841	113,916	70,524	35,921	70,524	70,524
Oil and Gas Constraints	Closed	12,444	96,366	12,444	21,691	15,948	63,594	15,948	15,820
	Major	10,232	16,933	6,744	1,644	12,466	6,929	3,978	2,607
	Moderate	77,013	0	73,658	89,964	26,062	0	13,434	52,096
	Open	4,174	639	11,017	639	16,048	0	37,164	0
Salable Minerals	Closed	15,608	113,299	22,972	21,691	15,951	70,524	16,486	15,948
	Open	88,255	513	80,891	92,247	54,573	0	54,038	54,576
Locatable Minerals	Withdrawn	0	0	0	0	0	0	0	0
	Open	103,863	113,938	103,863	113,938	70,524	70,524	70,524	70,524

Source: BLM 2009a
HMA Herd Management Area
ROW rights-of-way

Under Alternative A, 28,392 acres (16 percent) of HMAs are within WSAs, which will limit adverse impacts to HMAs from surface-disturbing activities. Surface disturbance and the removal of vegetation would directly limit the available forage for wild horses and other grazing animals and, without appropriate reclamation or rehabilitation, may also lead to the establishment and spread of invasive species, potentially contributing to forage reduction. Reductions in forage would impact wild horses by increasing competition between livestock and other wildlife.

Resource Uses

Management actions for minerals would result in both short-term and long-term impacts to wild horses. Mining activity would result in both short-term and long-term surface disturbance and loss of vegetation, which would reduce available forage. Construction and operation of mineral facilities and infrastructure would also displace horses and prevent movement in certain circumstances (e.g., linear infrastructure such as aboveground pipelines, transmission lines, and roads). Increased human presence and activity associated with mining may also reduce the wild and free-roaming nature of the horses.

Untreated invasive weeds that outcompete native vegetation and grasses may reduce available forage for wild horses. Treatments and reductions in invasive weeds may displace wild horses and reduce forage in the short term, but would reduce competition with native vegetation and increase available forage for wild horses in the long term. Under Alternative A, there would be beneficial impacts from treatments of invasive species on approximately 2,000 acres.

Management of ROWs would result in short- and long-term adverse impacts to wild horses. Wild horses would be displaced in the short term during construction activities and may be displaced in the long term depending on the size and activity level associated with ongoing operations on the ROW. The development of ROWs would also increase human activity and may result in avoidance behavior of wild horses, affecting access to resources and additional energy expenditure. Construction of ROWs and associated surface disturbance would result in short-term impacts to wild horses by removing forage. Successful reclamation of surface disturbance would reduce the potential for long-term loss of forage associated with ROW development. However, permanent (or long-term) facilities and infrastructure would still result in long-term surface disturbance that would reduce overall forage. Developing new ROWs in or adjacent to disturbed areas associated with existing ROWs or high traffic gravel roads or highways would reduce impacts to wild horses from the development of new ROWs. Alternative A has the most area open to ROW development in the Fifteenmile and McCullough Peaks HMAs (Table 4-10).

Management for travel and transportation would result in both short- and long-term impacts to wild horses. Travel designations that permit motorized vehicle use may disturb wild horses and result in short-term displacement when activity is occurring. In areas of frequent motorized vehicle use, wild horses may adjust behavior to adapt to human activity and noise, which may affect their wild and free-roaming nature and has been observed in the McCullough Peaks HMA. Areas open to cross-country motorized travel may reduce available vegetation and forage for wild horses; however, no areas in HMAs are completely open to cross-country motorized travel under any of the alternatives. Less than half of the area in HMAs is limited to designated roads and trails (Table 4-10). Limiting motorized vehicle use to designated roads and trails would limit adverse impacts to wild horses by restricting motorized access to help maintain their overall free-roaming and wild nature and to minimize disturbance.

Recreation management under Alternative A would result in localized short-term impacts to wild horses. Recreational activities may result in the temporary disturbance of horses from recreational wild horse viewing, hiking, hunting, camping, and other activities.

Livestock grazing management would result in adverse and beneficial impacts to wild horses. Impacts of livestock grazing on wild horses depend on the location, timing, intensity, duration, and frequency of grazing. Livestock grazing management results in the maintenance or improvement of range conditions as directed by the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N). Range improvements associated with livestock such as springs, wells, and reservoirs would also result in beneficial impacts to wild horses by increasing the availability of water. Conversely, fences constructed for range improvements may cause adverse impacts to wild horses by preventing herd movement and access to resources, necessitating additional management actions to open gates to allow horse movement. Livestock grazing may also result in competition for forage, water, and habitat with wild horses resulting in adverse impacts during periods of drought. Drought conditions can exacerbate conflicts between wild horses and livestock management relating to water and forage availability on rangelands and in HMAs. These impacts would occur only in the portions of HMAs managed as open to livestock grazing. Under Alternative A, over 99 percent of HMAs are open to livestock grazing (Table 4-10).

Special Designations

Management for regionally important prehistoric and historic trails (i.e., Other Historic Trails) would result in beneficial impacts to wild horses. The Bridger Trail passes through the eastern portion of the McCullough Peaks HMA. Restrictions on surface-disturbing activities, ROW development, and motorized vehicle use on and in the vicinity of the trail would result in beneficial impacts by reducing the potential for activities that would decrease forage and may disturb or displace wild horses.

Resources

Fire and fuels management would result in both adverse and beneficial impacts to wild horses. Management that increases the occurrence and spread of wildland fires in the short term, such as restrictions on fire suppression activities, would result in temporary displacement of wild horses and short-term reductions in available forage. However, fires of the appropriate intensity would improve forage production in the long term and result in vegetative communities with increased diversity, cover, and age class. Burned areas may also require fencing during stabilization and rehabilitation, which may temporarily decrease the movement of wild horses. Due to the short-term impact of these fences, they are not expected to affect the long-term genetic variability of wild horses.

Fire suppression activities, such as firebreaks and staging areas for suppression, would also result in short-term loss of forage. These impacts are expected to be minor, considering the amount of suppression activities and localized disturbance, compared to the size of the Planning Area and HMAs. However, the firebreaks historically have resulted in increased road use, which may fragment wild horse habitat. Any fire suppression activities in or near HMAs would increase short-term impacts to wild horses.

Mechanical fuels treatments, prescribed fire, and other fuels reduction activities may result in short- and long-term impacts to wild horses. However, most HMAs do not have a history of wildfires, and the likelihood of these areas receiving fuels treatments or being susceptible to wildfires is low. In the short term, any fuels reduction treatment that does occur may temporarily displace wild horses from localized areas. In the long term, any fuels reduction activities that help return fire to locations in the HMAs

where it historically facilitated ecosystem health would benefit wild horses through improved forage production and vegetative diversity.

Proactive Management

Under Alternative A, the McCullough Peaks HMA would be maintained at about 103,863 acres and the Fifteenmile HMA at 70,524 acres (Map 36). Providing opportunities for the public to view wild horses in the McCullough Peaks and Fifteenmile HMAs may result in both adverse and beneficial impacts to wild horses. Increased human presence may adversely impact wild horses by acclimating horses to human presence and reducing their wild, free-roaming nature. Increases in foal mortality due to foal abandonments and increased risk of injuries to humans would result as horses continue to be acclimated to humans. However, increasing public interest in wild horses may result in beneficial impacts to wild horses by heightening awareness of the wild horse program and public opportunities to adopt excess horses removed from the range. Adoption activities may result in public participation in and support for the wild horse management program and long-term management activities.

SRPs in the HMAs would result in impacts similar to those described above for providing opportunities for public viewing of wild horses. However, these impacts may be greater due to the closer proximity and larger scale of activities associated with SRPs, camps, events, activities, and an increase in the number of visitor use days. When SRP holders use horses, additional risks can result from wild stallions approaching domesticated mares that are in estrus (in season). In large groups, domesticated horses may also escape and join bands of wild horses; the SRP holder is responsible for any costs associated with the collection of their horses. Additional impacts would result from the introduction of parasites and diseases brought into the HMA by domestic horses.

Evaluating and potentially allowing fences in the McCullough Peaks HMA on a case-by-case basis may result in beneficial and adverse impacts to wild horses. Fences may help achieve healthier rangelands by allowing for rotational livestock grazing. Any fence decision would require site-specific analysis with public participation under NEPA to ensure the consideration of adequate alternatives and mitigations, including gate management and horse movement, before construction.

Mitigating surface-disturbing and disruptive activities in the Fifteenmile HMA would result in beneficial impacts to wild horses by reducing adverse impacts associated with these activities, as previously described.

Alternative B

Surface Disturbance

Impacts of surface disturbance on wild horses would be similar to those described under Alternative A, although to a lesser extent, because the projected overall surface disturbance in the Planning Area is less under Alternative B (Table 4-1). With the expansion of the McCullough Peaks HMA, 38,268 acres (21 percent) of HMAs are contained in WSAs, which would limit adverse impacts to HMAs from surface-disturbing activities. Implementation of Alternative B would result in the least amount of short- and long-term surface disturbance (46 percent and 31 percent less than Alternative A, respectively) compared to the other alternatives, and would therefore have the fewest adverse impacts to wild horses.

Resource Uses

Management of minerals would result in impacts similar to those under Alternative A, although to a lesser extent. Implementation of Alternative B would involve the least amount of mineral activity compared to the other alternatives. Alternative B closes the most acreage in HMAs to mineral activity (Table 4-10).

Management of invasive species would result in impacts similar to those under Alternative A. However, under Alternative B, the BLM would treat the smallest area (5 percent of the area treated under Alternative A) for invasive species compared to other alternatives, potentially allowing for increased weed establishment in HMAs, with associated forage reductions.

Management of ROWs would result in impacts similar to those under Alternative A, although to a lesser extent because there are more restrictions on ROW development under Alternative B. Alternative B includes more ROW avoidance/mitigation or exclusion areas in the HMAs compared to the other alternatives (Table 4-10). In addition, no areas are open to ROWs in the HMAs under Alternative B. ROW development would occur only in ROW avoidance/mitigation areas, where the BLM would apply appropriate mitigation measures and BMPs to limit impacts to wild horses and other resources.

Management of travel and transportation would result in impacts similar to those under Alternative A, although to a lesser extent. Under Alternative B, the BLM would close or limit to designated roads and trails motorized vehicle travel in the HMAs in more area than under the other alternatives (Table 4-10). Therefore, there would be fewer impacts from motorized vehicle use under Alternative B.

Impacts from recreation management under Alternative B would be similar to those under Alternative A.

Under Alternative B, less spring and reservoir developments associated with livestock grazing would be constructed compared to the other alternatives, resulting in fewer beneficial impacts to wild horses. Under Alternative B, 60,361 acres (32 percent) of the HMAs are managed as closed to livestock grazing (Table 4-10), reducing competition for forage across most of the area open to wild horses and resulting in a beneficial impact to these animals. Apportioning additional sustained yield forage for wild horses and wildlife would result in beneficial impacts to wild horses by increasing forage and decreasing the potential for competition with livestock and other wildlife. Alternative B results in the greatest potential additional forage available for wild horses, resulting in the greatest benefit to health and vigor for the constrained number of horses in the HMAs (i.e., 70 to 160 horses for the Fifteenmile HMA and 70 to 140 horses for the McCullough Peaks HMA).

Special Designations

Management of the Bridger Trail, which passes through the McCullough Peaks HMA, would result in similar beneficial impacts under Alternative B as those described under Alternative A, but to a greater extent due to the increased restrictions on resource uses and activities around the trail.

Resources

In general, management under Alternative B emphasizes the conservation and protection of resources (e.g., vegetation, water, and soils) which may improve forage and the health of wild horses. As a result, management of resources under Alternative B would have the greatest beneficial indirect impacts to wild horses compared to the other alternatives.

Impacts to wild horses from fire and fuels management would be similar to those under Alternative A. However, under Alternative B, the likelihood of mechanical treatments for fuels and prescribed fire use in the HMAs would be lower, which may further reduce the potential disturbance and displacement of wild horses. Fewer fuels treatments also may increase the potential for larger, more intense fires in the long term and associated adverse impacts to wild horses. However, as under Alternative A, such fires would likely remain uncommon due to the historical absence of wildfires in the HMAs.

Proactive Management

Under Alternative B, expansion of the McCullough Peaks HMA and maintaining the initial appropriate management level of horses in the HMA would result in beneficial impacts to wild horses (Map 36). Beneficial impacts include accommodating the routine movement of wild horses, which is in conflict with the currently designated HMA, and reducing the need for roundups to remove horses outside of the HMA. Providing opportunities for wild horse viewing in the McCullough Peaks HMA would have the same impacts as those described under Alternative A. However, not promoting wild horse viewing in the Fifteenmile HMA under Alternative B may help retain the remote natural conditions and the wild and free-roaming nature of horses compared to Alternative A. Opportunities for wild horse viewing would be less under Alternative B compared to alternatives A and C, but only in the Fifteenmile HMA.

Prohibiting horse use-based organized SRPs in the HMAs would result in beneficial impacts to wild horses by retaining the remoteness of the herds and reducing the potential for human and domestic horse interaction that would reduce the wild and free-roaming nature of the horses. The chance of domestic horses joining wild horse herds, which would result in stress and harassment to wild horses from recapturing domestic horses and potential disease and parasite transmission, would be greatly reduced. However, this prohibition would reduce public opportunities to gain an appreciation for wild horses, possibly reduce adoption demand, and restrain public interest in wild horse management in the Planning Area.

Evaluating and removing interior fences in the McCullough Peaks HMA would result in beneficial impacts to wild horses by allowing movement in the HMA, increasing genetic viability, and reducing injuries and deaths.

Under Alternative B, applying seasonal restrictions from February 1 to July 31 to surface-disturbing and disruptive activities and land uses in the McCullough Peaks and Fifteenmile HMAs, as appropriate, and avoiding wild horse gathers from 6 weeks before to 6 weeks after foaling would beneficially impact wild horses by reducing the potential for foal abandonment or jeopardy of wild horse health and welfare.

Relative to all alternatives, Alternative B would result in the most indirect beneficial impacts to wild horses and their habitat because it conserves the most land area for physical, biological, and heritage resources and is the most restrictive to motorized vehicle use and mineral development.

Alternative C

Surface Disturbance

Impacts from surface disturbance on wild horses under Alternative C would be similar to those described under Alternative A, although to a greater extent. Similarly to Alternative A, 28,392 acres (16 percent) of HMAs are contained in WSAs, which will limit adverse impacts to HMAs from surface-disturbing activities under Alternative C. However, Alternative C is projected to result in the greatest amount of short- and long-term surface disturbance in the Planning Area (80-percent and 164-percent more than Alternative A, respectively), increasing the probability that surface disturbance would adversely affect wild horse habitat.

Resource Uses

Management of minerals under Alternative C would result in impacts similar to those under Alternative A, although to a greater extent. Implementation of Alternative C would result in the greatest amount of minerals development compared to other alternatives (Appendix T). There would be less acreage closed to mineral activity in the HMAs under Alternative C than under other alternatives (Table 4-10).

Management of invasive species would result in impacts similar to those under Alternative A.

Management of ROWs would result in impacts similar to those under Alternative A, although to a lesser extent because there are more restrictions on ROW development under Alternative C. Compared to Alternative A, Alternative C includes more ROW avoidance/mitigation areas and less area open to ROW development within HMAs. Overall, Alternative C would result in the second-greatest adverse impact to wild horses from ROW development.

Management of travel and transportation would result in impacts similar to those under Alternative A, although to a greater extent. Under Alternative C, the BLM would not close areas to motorized vehicle travel in the Fifteenmile HMA and would limit motorized vehicle travel to designated roads and trails in HMAs in more area than under Alternative A, but less than under alternatives B and D (Table 4-10).

Impacts from recreation management would be similar to those described for Alternative A.

Management of livestock grazing, including areas in the HMAs closed to livestock grazing (Table 4-10), under Alternative C is similar to Alternative A, thereby resulting in similar impacts. Under Alternative C, additional sustained yield forage would only be apportioned to satisfy suspended permitted use of permittees and not for the benefit of wild horses or other wildlife as under Alternative B. This management action would result in the fewest beneficial impacts to wild horses from forage apportionment.

Special Designations

Management of the Bridger Trail, which passes through the McCullough Peaks HMA, would result in similar beneficial impacts under Alternative C as those described under Alternative A, but to a greater extent due to greater restrictions around the trail under Alternative C. Management of the Bridger Trail under Alternative C would result in more restrictions on resource uses and activities than Alternative A, but less than alternatives B and D.

Resources

In general, management under Alternative C would emphasize resource use over resource conservation, which would result in more adverse impacts to forage and the health of wild horses, compared to the other alternatives. As a result, management of resources under Alternative C would have the greatest adverse impacts on wild horses compared to other alternatives.

Impacts to wild horses from fire and fuels management would be similar to those under Alternative A, although to a greater extent because the BLM would perform mechanical fuels treatments and prescribed burns on more acreage. Impacts from vegetation management in the Planning Area to wild horses under Alternative C would be similar to those under Alternative A. However, Alternative C does not prohibit surface-disturbing activities in riparian/wetland areas, which may cause short- and long-term adverse impacts.

Proactive Management

Under Alternative C, the McCullough Peaks HMA would be maintained at about 103,863 acres and the Fifteenmile HMA at 70,524 acres (Map 36). Wild horse viewing would be actively promoted in the

McCullough Peaks HMA with opportunities for public viewing, education, and interpretation under this alternative. Opportunities for wild horse viewing would also be provided in the Fifteenmile HMA. In general, management under Alternative C would result in the same level of wild horse viewing as under Alternative A, but less than under alternatives B and D.

The beneficial impacts from evaluating and removing interior fences in the McCullough Peaks HMA realized under alternatives B and D would not occur under this alternative.

Alternative C does not include seasonal restrictions on surface-disturbing or disruptive activities in HMAs. This would result in long-term adverse impacts to wild horses by increasing the potential for disturbance to wild horses during sensitive times of the year and by reducing forage and overall health of horses in the HMAs. Allowing SRPs in HMAs would cause impacts similar to those under Alternative A, although to a greater extent because the BLM would issue more SRPs under Alternative C. Evaluating fences on a case-by-case basis in the McCullough Peaks HMA would cause the same impacts as under Alternative A. Overall, proactive management for the protection of wild horses would provide the least beneficial impacts under Alternative C.

Alternative D

Surface Disturbance

Impacts of surface disturbance on wild horses would be similar to those described under Alternative A, although to a slightly greater extent because the projected short- and long-term surface disturbance in the Planning Area is 3 percent and 17 percent more, respectively, under Alternative D. The expansion of the McCullough Peaks HMA would be the same as under Alternative B, resulting in 38,268 acres (21 percent) of HMAs being contained in WSAs, which will limit adverse impacts to HMAs from surface-disturbing activities.

Resource Uses

Management of minerals would result in impacts similar to those under Alternative A. The amount of disturbance associated with minerals development is projected to be slightly less than under Alternative A. In HMAs, the acreage closed to mineral activity under Alternative D is greater than under alternatives A and C, but less than under Alternative B (Table 4-10).

Management of invasive species would result in impacts similar to those under Alternative A.

Management of ROWs would result in impacts similar to those under Alternative A, although to a lesser extent because there are more restrictions on ROW development under Alternative D. The BLM would manage the majority of the McCullough Peaks and Fifteenmile HMAs as ROW avoidance/mitigation areas where mitigation measures and the application of BMPs would limit impacts to wild horses (Table 4-10). Overall, Alternative D would result in the second-fewest adverse impacts to wild horses from ROW development.

Under Alternative D, HMAs are closed to motorized vehicle use or it is limited to designated roads and trails on more acreage than under alternatives A and C, but less than under Alternative B. The overall adverse impacts to wild horses from travel management would be similar to those described under Alternative A, although to a lesser extent. Restricting motorized travel would benefit wild horses by minimizing surface disturbance and stress to wild horses associated with motorized vehicle use.

Impacts from recreation management under Alternative D would be similar to those described under Alternative A.

The amount of rangeland improvement projects, such as springs, reservoirs, and fence development, constructed under Alternative D would be similar to that under Alternative A, resulting in similar adverse and beneficial impacts. Under Alternative D, the BLM would manage the same amount of acreage as open to livestock grazing as under Alternative A (Table 4-10), resulting in impacts similar to those under Alternative A.

Special Designations

Under Alternative D, management of the Bridger Trail, which passes through the McCullough Peaks HMA, would cause beneficial impacts similar to those under Alternative A, but to a greater degree due to increased restrictions on resource uses and activities around the trail. Management of the Bridger Trail under Alternative D would result in more restrictions on resource uses and activities than under alternatives A and C, but less than under Alternative B.

Resources

Management designed to protect resources such as soil, water, and vegetation would benefit wild horses by limiting surface-disturbing activities and minimizing impacts to forage and habitat. Several management actions require avoidance of surface-disturbing activities for the protection of resources under Alternative D. In areas that require avoidance, surface-disturbing activities would be prohibited unless the impacts could be mitigated, thereby limiting long-term adverse impacts to wild horses.

Prescribed fire and mechanical fuels treatments are projected to disturb the same acreage as Alternative A, therefore causing similar impacts.

Proactive Management

Similar to Alternative B, expansion of the McCullough Peaks HMA and maintaining the initial appropriate management level of horses in the HMA would result in beneficial impacts to wild horses (Map 36). Under Alternative D, the BLM would promote opportunities for public viewing, education, and interpretation of wild horses in the McCullough Peaks HMA, but would not actively promote the Fifteenmile HMA to the public. Under Alternative D, fewer opportunities for wild horse viewing would exist in the Fifteenmile HMA than under alternatives A and C, resulting in similar beneficial impacts to those under Alternative B. In general, opportunities for wild horse viewing in the McCullough Peaks HMA would be similar under all alternatives, resulting in impacts similar to those described under Alternative A.

Under Alternative D, the BLM would prohibit and avoid, respectively, organized SRPs using domestic horses in the McCullough Peaks and Fifteen Mile HMAs. Restricting SRPs using domestic horses in the HMAs would result in impacts similar to those described under Alternative B. Although SRPs are not prohibited in the Fifteenmile HMA, avoidance would require that impacts are mitigated, reducing the potential for long-term impacts.

Evaluating and removing interior fences in the McCullough Peaks HMA to provide for wild horse movement would result in similar beneficial impacts as those under Alternative B.

Seasonal restrictions to prevent foal abandonment and jeopardy of wild horse health would result in similar beneficial impacts as those under Alternative B, although to a lesser extent because the restrictions would not apply to disruptive activities.

4.5 Heritage and Visual Resources

4.5.1 Cultural Resources

Because cultural resources are fragile, often unique, nonrenewable resources that occupy relatively small areas, almost any management action has the potential to affect the resource. Actions under each alternative may directly or indirectly affect cultural resources, and impacts may be beneficial or adverse. Except for setting, there is little distinction between short- and long-term impacts. Section 4.7.4 *National Historic Trails and Other Historic Trails* in this chapter analyzes historic trails in detail. This section and Section 4.8.5 *Tribal Treaty Rights* identify Native American concerns.

Direct adverse impacts to cultural resources from RMP alternatives typically result from actions that disturb the soil or physically alter, damage, or destroy all or part of a resource; alter characteristics of the surrounding environment that contribute to resource significance; introduce visual or audible elements out of character with the property or alter its setting; or result in neglect or physical exposure of the resource to the extent that it deteriorates or is destroyed. Surface-disturbing activities would result in direct adverse impacts because, once a cultural resource has been disturbed, it cannot be replaced and the potential for collecting or preserving meaningful data is compromised. Actions resulting in data collection and preservation of cultural resources are considered to be neutral or not adverse impacts, as the actions merely maintain the status quo. Indirect impacts to cultural resources result from project-induced increases or decreases in activity in the Planning Area, such as an interpretive area that increases visitor use. A beneficial impact to cultural resources enhances their value (for example, constructing interpretive signs). Paradoxically, the same actions that can result in direct or indirect adverse impacts also may result in beneficial impacts. The discovery of previously unknown cultural resources, or the facilitation of data collection, preservation, or public education are possible beneficial impacts.

Once a cultural resource is physically altered, the impact is permanent; therefore, there is no difference between short- and long-term direct impacts from surface disturbance. Stabilization can halt deterioration, and restoration may be possible in unique situations; however, the disruption of cultural deposits on archeological sites and the deterioration of rock art, for two examples, are irreversible. For indirect impacts, the duration of a disturbing element or activity can be short or long. As examples, a pipeline construction corridor that results in erosion to or deposition on a cultural resource may be a short-term disturbance, because normal reclamation ultimately stabilizes the soil. A disturbance lasting more than 5 years is considered long-term.

The BLM complies with NHPA Section 106 for all actions with the potential to adversely impact historic properties (cultural resources eligible for listing or listed on the National Register of Historic Places [NRHP]). Section 106 compliance typically includes a cultural resources inventory and evaluation of any resources found. If historic properties are present, the BLM consults with the State Historic Preservation Office (SHPO), interested Native American tribes, and other interested parties to develop measures to mitigate adverse impacts to affected historic properties.

Under all alternatives, the BLM continues its obligation to engage in government-to-government consultations with interested tribes regarding sensitive resources in the Planning Area. Impacts to Native American traditional resources or sacred sites are identified in consultation with the affected tribes. Alterations to the important characteristics of traditional or sacred resources can adversely impact traditional use of the area. While temporary disturbances, such as construction activities, may not be of major concern, long-term increases in noise, changes in visual setting and smells, and

increases in motion and activity, all have the potential to detract from a site's setting. In addition, physical impacts to traditional or sacred sites and limitations on tribal access can impact traditional uses.

The BLM initiated contact with the following tribes, listed alphabetically, to identify potential impacts of the alternatives to sites of cultural concern on BLM lands:

- Blackfeet, living on the Blackfeet Reservation, Browning, Montana
- Crow, living on the Crow Reservation, Crow Agency, Montana
- Nez Perce, living on the Nez Perce Reservation, Lapwai, Idaho
- Northern Arapaho, living on the Wind River Reservation, Fort Washakie, Wyoming
- Northern Cheyenne, living on the Northern Cheyenne Reservation, Lame Deer, Montana
- Salish and Kootenai, living on the Flathead Reservation, Pablo, Montana
- Shoshone, represented by two tribes
  - Eastern Shoshone, living on the Wind River Reservation, Fort Washakie, Wyoming
  - Shoshone Bannock, living on the Fort Hall Reservation, Fort Hall, Idaho
- Sioux, represented by three tribes
  - Cheyenne River Sioux living on the Cheyenne River Reservation, Eagle Butte, South Dakota
  - Oglala Sioux, living on the Pine Ridge Reservation, Pine Ridge, South Dakota
  - Rosebud Sioux, living on the Rosebud Reservation, Rosebud, South Dakota

4.5.1.1 Methods and Assumptions

For all federal undertakings that may affect cultural resources, the BLM complies with NHPA Section 106 before proceeding with the undertaking. Section 106 compliance typically includes inventory and evaluation, and consultation with the SHPO. Existing Planning Area plans considered the maintenance of a ¼-mile-wide buffer zone adequate protection in most site situations, and the occasional application of a 5-mile-wide buffer zone a generous allowance that would protect the viewshed of the resource. However, with the introduction of new technologies, particularly wind turbines that are often grouped into wind farms, these distances do not always protect the significant values of a resource. Because the historic preservation community has begun placing more emphasis on setting as the initial aspect of integrity for a NRHP-eligible cultural resource, management must approach the application of viewshed criteria with flexibility, and account for the distance from the resource and the type of intrusion when determining the impact. On a case-by-case basis, and as appropriate for some projects, project decisions account for the importance of viewshed in a resource's eligibility and the distance necessary to protect its NRHP significance.

Methods and assumptions used in this impact analysis include the following:

- Cultural resources will continue to be found throughout the Planning Area.
- All surface-disturbing activities may damage, destroy, or otherwise impact cultural resources.
- Natural and prescribed fire may damage rock art sites and sites composed of combustible materials.
- Compliance with Section 106 before project initiation is required by law. All cultural resources will be protected in accordance with federal laws and BLM regulations and agreements, including the national programmatic agreement (BLM, Advisory Council on Historic Preservation, and National Conference of State Historic Preservation Officers 1997) and the

Wyoming State Protocol (BLM and Wyoming SHPO 2006), regardless of whether the resources are specifically identified in the RMP.

- Avoidance is the preferred mitigation measure. When avoidance is not a practicable solution, the BLM will develop measures to mitigate impacts in accordance with Section 106 and other applicable laws and guidance.
- Adverse impacts to historic properties from surface-disturbing activities occur primarily at the time of initial surface disturbance. The BLM used the projected numbers for short-term surface disturbance to quantify impacts to cultural resources.
- The intensity of surface disturbance by alternative, as identified in Appendix T, equates to levels of development and, in turn, increased access to public lands.
- Increases in the number and extent of surface-disturbing activities and improved access may all result in increased impacts to cultural resources.
- The BLM has not identified all tribally sensitive sites in the Planning Area.
- Identifying tribally sensitive sites will benefit heritage resources.
- Tribal consultations benefit heritage resources.

4.5.1.2 Summary of Impacts by Alternative

Because cultural resources are fragile, often unique, nonrenewable resources that occupy relatively small areas, almost any management action has the potential to affect them. Principle impacts to cultural resources result directly from surface disturbance or visual intrusions, and indirectly from increased access related to management of other resources. The BLM anticipates impacts to cultural resources from the alternatives to be similar in type, but different in intensity. Proactive cultural resource management actions result in beneficial impacts across all alternatives. Overall, Alternative C allows the most resource use; therefore, it likely will result in the most direct and indirect impacts, adverse and beneficial, to cultural resources. However, despite the most use and the most potential impact, Alternative C incorporates a contemporary understanding of cultural resources management, in contrast to current management (Alternative A), which reflects the status of cultural resource management from the 1980s. While the BLM instituted current management in good faith and in compliance with Section 106 and BLM regulations, improved approaches and increased knowledge of options allow for more protection, even with more resource use. Potential impacts are likely to be the least adverse under Alternative B because of more restrictions on resource uses for the protection of other resources. However, with less use of other resources, there also is likely to be less Section 106 compliance and associated inventory, so that the knowledge base will not grow at the same rate as it would under Alternative C. Alternative D reflects a balanced approach overall, in some cases mirroring the active management recommendations of Alternative A, providing less specific protection than Alternative B, but acknowledging and specifying situations in which more protective measures will be needed than under alternatives A or C.

Under all alternatives, the BLM continues its obligation to engage in government-to-government consultations with interested tribes. Actions required by the NHPA and the Wyoming State Protocol will form the foundation of all project-specific decisions regarding cultural resources. The Wyoming State Protocol and NHPA provisions will resolve conflicts between cultural resources and other resource uses not addressed in the RMP.

4.5.1.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Potential impacts to cultural resources are similar under all alternatives; however, the BLM anticipates that the intensity of impacts will vary. Therefore, impacts to cultural resources from surface-disturbing activities related to management of other resources are described for individual alternatives. Essentially, any activity that disturbs or has the potential to disturb the surface, regardless of the resource program with which the activity is associated, has the potential to affect cultural resources. Other types of disturbance also can affect cultural resources, including the adverse interaction of vibration impact, dust and airborne chemicals on rock art sites.

A number of management actions are common to all alternatives. These fall into several categories. Reactive actions include the investigation of all alleged violations of the Archeological Resources Protection Act; emergency site stabilization and long-term protection projects on important sites as appropriate, including the Hanson Site and several rock art occurrences; and assignment of an archeologist to all fires with heavy equipment employed beyond Minimum Impact Suppression Techniques (see *Glossary*) to assist in determinations of appropriate suppression strategies.

Native American consultation actions, which can affect how the BLM manages cultural resources, include continuing existing relationships and development of new relationships with Native American tribes to identify sites, areas, and resources important to them; documenting and maintaining confidentiality of sites, areas, and resources worthy of protection and the incorporation of information obtained from the tribes into the planning system; identifying resource conflicts in the earliest stages; avoiding these conflicts whenever possible; and managing identified areas of tribal importance to minimize disturbance to them and to ensure continued access. The BLM must ensure that areas important to Native American communities are not transferred from federal ownership, physically modified, or affected by management actions in ways that restrict or deny access and/or use. The BLM also must inventory potentially sensitive cultural places identified during Native American consultations independent of specific land use actions and apply tools (such as site avoidance and buffer areas) to protect sensitive cultural sites, as necessary.

Under all alternatives, all cultural properties will be categorized according to the six use allocations defined in BLM Manual 8110 (BLM 2004d) – scientific use, conservation use, public use, traditional use, experimental use, and discharged from public use.

Under all alternatives, compliance with NHPA Section 106 before an action is approved serves to moderate the amount of actual disturbance to cultural resources. In cases in which there can be no accommodation, the BLM and the SHPO consult to develop and implement a treatment plan to mitigate adverse impacts to historic properties. Often, this results in data recovery, which can take the form of planned excavation, detailed recording and mapping, or Historic American Buildings Survey/Historic American Engineering Record documentation. Other options include interpretation, one of many techniques that can be used for impact mitigation, depending on the type of site and the nature of the potential adverse impacts.

Exploration and development of locatable minerals may result in adverse impacts to cultural resources from the discovery and inadvertent destruction or degradation of cultural resources during project activities. Current regulations require operators to notify the BLM if cultural resources are discovered to reduce potential impacts to those resources. Under current policy, the BLM must allow mining operations to proceed within 10 working days after notification to the authorized officer of a discovery of cultural resources that might be altered or destroyed on BLM-administered lands by operations (43

CFR 3809.420(b)(8)(ii)). This requirement also applies to not only a plan of operations that requires an approval of an action, but also for operations under a 3809 notice, which does not require agency approval before commencing actions.

For all alternatives, the BLM identified proactive management actions that would have a beneficial impact on cultural resources. These actions include preparation of activity plans for important sites, as appropriate (including the Hanson Site and several rock art occurrences), Ten Sleep Raid, Minick Sheep Camp Raid, historic trails (including the Bridger Trail), and the Fort Washakie to Red Lodge stage route; management of the Legend Rock Petroglyph Site for public education in cooperation with the state of Wyoming; and initiation of work to acquire the private land portions of the Legend Rock Petroglyph Site from willing landowners, preferably through a land exchange. The BLM also will develop additional cultural resource interpretive sites employing scenic overlooks, signs, and walking trails. Surface-disturbing activities associated with the construction and use of sites and facilities are subject to appropriate mitigation developed through implementation of the National Programmatic Agreement (BLM, Advisory Council on Historic Preservation, and National Conference of State Historic Preservation Officers 1997) and the State Protocol (BLM and Wyoming SHPO 2006). Based on analysis and assessment, the BLM may need to apply additional restrictions beyond those specifically described in the alternatives.

Proactive management actions that protect cultural resources include prohibiting the use of bulldozers in areas of significant cultural resources or historic trails for fire suppression unless an archeologist is present, and restricting or prohibiting the use of fire-retardant chemicals to protect rock art. All alternatives apply an NSO restriction on the Legend Rock Petroglyph Site and pursue withdrawals on a case-by-case basis for the protection of important cultural sites. The BLM also limits the use of motorized vehicles to designated roads and trails in areas with significant cultural and paleontological resources to reduce the potential for looting and resource degradation.

Alternative A

Surface Disturbance

Any action that results in surface disturbance or subsurface disturbance (as identified in Appendix T) through culture-bearing strata may impact cultural resources. However, the net potential adverse impact to historic properties is limited because compliance with NHPA Section 106 requires the application of some type of mitigation to historic properties before any disturbance. The relative amount of surface disturbance projected for each alternative defines the level of potential to impact cultural resources. Under Alternative A, the BLM anticipates that impacts to cultural resources from surface-disturbing activities would increase with a greater intensity of surface disturbance, represented by the reasonable foreseeable actions shown in Appendix T. Moreover, the BLM anticipates that impacts to cultural resources from surface disturbance under Alternative A would primarily be adverse.

Restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations) under Alternative A provide additional protection for cultural resources.

Resource Uses

Resource exploration, development, and extraction can result in a long-term, direct adverse impact. Associated resources in the Planning Area, including locatable minerals, leasable minerals, mineral materials disposal, and forest products, all can lead to surface disturbance that may affect cultural resources. In addition to the actions required to develop these resources, associated actions, such as

the creation and use of roads and other utilities, may impact cultural resources. Dust and vibration from some methods of resource exploration can result in a direct impact to rock art. The dust accumulates on the panels and can degrade the paint, and vibrations from blasting can cause spalling and rock fall that also adversely affects rock art. The BLM anticipates that these actions will occur under Alternative A.

Under Alternative A, the BLM pursues leasable mineral and mineral material restrictions to protect cultural resource sites on a case-by-case basis. The allowance for more case-by-case management under Alternative A, while providing discretionary protection, increases the chance of adverse impacts to cultural resources. Development of locatable minerals may result in adverse impacts to cultural resources if activities degrade or destroy resources. Pursuing mineral withdrawals would result in beneficial impacts to cultural resources by prohibiting mineral activities that may degrade or destroy resources. Under Alternative A, the BLM pursues withdrawals on a total of 174,354 acres.

Land exchanges may result in both beneficial and adverse impacts. The survey required for compliance with NHPA Section 106 in the case of either disposal or acquisition would result in a beneficial impact because of data that furthers understanding of cultural resources in the Planning Area. In addition, if the BLM acquires land with sensitive resources for the purpose of managing that resource, that would be beneficial. However, if historic properties are identified during the inventory, it may result in an adverse impact because once in private ownership, there are no protective measures for cultural resources. For that reason, Section 106 classifies land-tenure adjustment as an adverse impact. Alternative A identifies 116,800 acres as available for disposal, resulting in the potential for adverse impacts.

Any resource use that includes road development has the potential to result in direct impacts to cultural resources because the road may pass through or over a site. These resource uses may include any resource use already mentioned, but also invasive species and pest management, CTTM, and recreation. An indirect impact from this type of development occurs when the road provides access to a previously remote and/or inaccessible location. People who gain access may inadvertently damage fragile resources, or may vandalize or loot sensitive sites, particularly rock art and rock shelters. The BLM anticipates that Alternative A would result in 3,199 acres of short-term disturbance from new road construction and motorized vehicle use (Appendix T).

ROWs and corridors, renewable energy, CTTM, and recreation can result in similar impacts. The linear nature of corridors means they can reach far into areas where remoteness previously provided protection for the cultural resources. Balancing the needs of recreation with preservation presents a challenge because increased recreational use of an area exposes the cultural resources there to inadvertent damage and potential vandalism and looting. Under Alternative A, the BLM manages 941,778 acres as ROW avoidance/mitigation areas and 61,416 acres as ROW exclusion areas. Renewable energy development is considered on a case-by-case basis, consistent with applicable policy and guidance and other resource management objectives, including cultural resource objectives. CTTM designations that place fewer restrictions on access to portions of the Planning Area, such as limiting travel to existing roads and trails (2,332,355 acres under Alternative A), would result in indirect adverse impacts to cultural resources by increasing the possibility of looting and vandalism. In contrast, CTTM that places greater restrictions on the routes available for use (e.g., limiting travel to designated roads and trails; 787,626 acres) or closes these routes altogether (59,192 acres) may reduce such impacts. Prohibiting and avoiding surface-disturbing activities in specified recreation areas would benefit cultural resources.

Livestock trampling and wallowing in areas of concentrated livestock use can directly affect cultural artifacts and features on or just below the surface by breaking or scattering these artifacts. Placing salt

blocks increases the local adverse impact because cows lick the soil as the salt block melts into the ground. Alternatively, cattle trails and other heavily trampled and exposed areas can unearth otherwise undetected cultural resources and allow them to be identified and recorded, resulting in a beneficial impact. However, in most cases concentrated livestock grazing would result in adverse impacts. Properly managing livestock grazing can mitigate these impacts by improving the distribution of livestock and reducing instances of concentrated use by these animals. Restrictions on livestock grazing also can help reduce impacts by limiting the area in which livestock can graze, and closures under Alternative A would generally benefit cultural resources. However, even in areas closed to livestock grazing, the presence of wildlife or wild horses may result in some impacts from trampling and wallowing.

Special Designations

Under Alternative A, the BLM manages three ACECs (Sheep Mountain, Little Mountain, and Upper Owl Creek) for their cultural values (among other values). Managing these areas as ACECs would provide additional protection to cultural resources and reduce the potential for adverse impacts.

Resources

Management actions related to other resources have the potential to impact cultural resources. As discussed above, compliance with BLM regulations and guidance and NHPA Section 106 would prevent some of the impacts and mitigate others. However, impacts are still possible, and most would be adverse. There may be some beneficial impacts. For example, standards for air quality that reduce dust and chemicals in the air would reduce adverse impacts to rock art and improve the viewshed for cultural resources where setting is an integral part of NRHP eligibility. Similarly, protecting cave and karst resources would benefit cultural resources in these areas.

Fire, fuels, and vegetation management may result in adverse or beneficial impacts. Protecting resources from fire reduces adverse impacts from heat, such as spalling at rock art sites. Protecting resources from fire also protects against the loss of vegetative cover, which protects cultural resources from the effects of erosion and provides camouflage for sensitive resources, protecting them from inadvertent and purposeful damage. However, fire management also can result in adverse impacts from loss of cover, firebreak construction, clearing vegetation, and revegetation activities (e.g., reseeding) and deployment of fire retarding chemicals. Prescribed fire is used on approximately 40,000 acres in the Planning Area over the life of the plan.

Wild horse management under Alternative A allows visitor access to HMAs and recreational use of some HMAs, which may result in greater access to remote areas and put cultural resources at risk.

Proactive Management

Under Alternative A, the BLM manages cultural resources proactively in compliance with BLM regulations and guidelines and the NHPA. The BLM strives to meet its Section 110 responsibility through inventory, and Section 106 compliance through identification, evaluation of cultural resources and mitigating impacts to those resources. Proactive management includes further exploration of the Hanson site, with the goal of nominating it as a National Historic Landmark. Alternative A emphasizes the management of rock art and other archeological sites for research and interpretation, and for preservation for future study. As previously noted, this alternative pursues restrictions on leasable minerals to protect sites on a case-by-case basis and takes similar actions for mineral materials disposal and the location of renewable energy development.

Alternative A manages portions of the town of Gebo and adjacent coal mining areas for preservation and interpretation of cultural and historic values and emphasizes management of historic oil and gas fields for scientific and public use.

Alternative B

Surface Disturbance

As for all the alternatives, any action that results in surface disturbance or subsurface disturbance through culture-bearing strata may affect cultural resources. Overall, Alternative B would involve the least surface disturbance; therefore, it would result in the fewest impacts to cultural resources associated with surface and subsurface disturbances.

Under Alternative B, there are more restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations), providing additional protection for cultural resources and reducing adverse impacts. Paradoxically, because less surface disturbance would result in less Section 106 compliance and therefore less cultural resources surveying, the beneficial impacts from such surveys would be lowest under this alternative.

Resource Uses

Activities associated with resource exploration, development, and extraction that can have a long-term, direct adverse impact on cultural resources will be less under Alternative B than under the other alternatives. Not only will these activities be reduced from Alternative A, Alternative B provides more avoidance protection, including larger buffer zones (see the 'Proactive Management' section, below).

Alternative B applies an NSO restriction for leasable minerals within 3 miles of important cultural sites and a CSU stipulation within 5 miles, in contrast to management under Alternative A, which pursues restrictions on a case-by-case basis. Alternative B also provides a larger buffer zone than Alternative D, which protects the foreground of important cultural sites up to 3 miles where setting is an important aspect of the integrity of the site, and Alternative C, which applies an NSO restriction within ¼ mile of important cultural sites and a CSU stipulation within 1 mile of important cultural sites. Under Alternative B, mineral materials disposal are prohibited within 3 miles or in view within 5 miles of important cultural sites. These mineral restrictions would benefit cultural resources by prohibiting surface disturbance from mineral activities in areas with cultural sites or resources that may degrade or destroy these resources. Impacts to cultural resources from locatable mineral development would be similar to those described for Alternative A, although to a lesser degree because withdrawals are pursued in more area (325,102 acres) than under Alternative A.

The types of impacts from land exchanges under Alternative B are the same as those under Alternative A, although the intensity varies by alternative. Under all alternatives, land available for disposal would be surveyed for the presence of cultural resources, but after disposal it would not necessarily be protected from adverse impacts. Alternative B identifies more area for disposal (including special disposal and disposal for specific uses) than Alternative A, resulting in a greater potential for adverse impacts. However, the BLM expects that most adverse impacts associated with land tenure adjustments would be mitigated through Section 106 compliance and because disposal in areas available for special disposal (Zones 1B and 1C; most of the area available for disposal under Alternative B) would occur only rarely and only under special circumstances.

As described for Alternative A, any resource use that includes road development can result in direct impacts to cultural resources. The BLM anticipates that Alternative B would result in the least amount

of new road construction compared to the other alternatives, with the result that Alternative B would result in the fewest impacts to cultural resources.

The types of impacts associated with ROWs and corridors, renewable energy, CTTM, and recreation are the same as described for Alternative A, although the intensity varies under Alternative B. Alternative B is anticipated to result in fewer ROW authorizations than the other alternatives and a greater degree of ROW consolidation to limit impacts. In contrast, it has more than twice the trails and recreational development of Alternative A, but half that of Alternative D, and about one-fifth that of Alternative C. The BLM manages areas within 5 miles of trails and sites eligible for the NRHP and traditional cultural properties (TCPs) as renewable energy (specifically, wind turbine) exclusion areas, unless the structures are screened from the site by intervening topography. Under Alternative B, this requirement is more specific and more protective of these resources than under Alternative A, which has no specific management for such development and manages it on a case-by-case basis. CTTM under Alternative B includes a greater amount of area limited to designated road and trails or closed (2,054,228 acres and 136,474 acres, respectively), and less area limited to existing roads and trails than under Alternative A. Adverse impacts from looting and trespassing due to increased access may be less under this alternative than Alternative A.

The types of impacts from livestock grazing under Alternative B are similar to those described under Alternative A, although grazing under Alternative B has more restrictions than all the other alternative, resulting in less potential for adverse impacts to cultural resources.

Special Designations

Under Alternative B, the BLM manages the three Alternative A ACECs that include cultural resources among their values of concern (Sheep Mountain, Little Mountain, and Upper Owl Creek) and expands the Carter Mountain ACEC to include cultural resources. Expansion of the Carter Mountain ACEC would result in the greatest beneficial impacts to cultural resources in relation to other alternatives, particularly Alternative C, under which the BLM does not manage any of the previously mentioned areas as ACECs.

In contrast to Alternative A, under Alternative B, the BLM designates all LWCs as Wild Lands and manages them to protect their wilderness characteristics, which would benefit cultural resources by limiting access and travel, imposing more restrictive VRM, and limiting minerals leasing. The only action in Wild Lands that results in direct impacts to cultural resources is the restriction that excavation of cultural resource sites is allowed only where scientific information would be collected under permit, with minimum site disturbance.

Resources

As described for Alternative A, management actions related to other resources have the potential to result in both adverse and beneficial impacts to cultural resources. Measures that protect other resources and that may, in turn, protect cultural resources are similar under all four alternatives, with slightly more protection under Alternative B than under the other alternatives.

Impacts from fire and fuels management under Alternative B would be similar to those under Alternative A. However, under Alternative B, the BLM would initiate less prescribed fire than under any of the other alternatives; therefore, Alternative B would present less potential for adverse impacts. The same is true for silvicultural treatments and timber harvesting, both of which would occur less frequently under Alternative B, resulting in less potential for adverse impacts.

Wild horse management under Alternative B includes more restrictions to HMAs than under the other alternatives, which would have the added beneficial impact of limiting access to remote areas that may contain significant cultural resources.

Proactive Management

In addition to the BLM managing cultural resources in accordance with its regulations and federal laws, Alternative B would augment existing plans and add a number of proactive measures. The overall approach would implement projects for the investment of maximum cultural resources protection. For further exploration of the Hanson site with the goal of nominating it as a National Historic Landmark, Alternative B would identify and test other deposits of similar age to determine the full extent of Folsom-age deposits. Compared to the Alternative A emphasis on managing rock art and other archeological sites for research and interpretation, and preservation for future study, Alternative B would explicitly avoid surface-disturbing activities and ROW authorizations in view within 5 miles of important cultural sites where integrity of setting is a contributing element of NRHP significance, except within designated utility corridors. In contrast to the case-by-case management approach under Alternative A, Alternative B applies an NSO restriction for leasable minerals within 3 miles and a CSU stipulation in view within 5 miles of important cultural sites, and follows a similar plan for mineral materials disposal. Alternatives B, C, and D identify exclusion areas for renewable energy development. Alternatives B and C also impose visual restrictions, depending on the topography, for sites eligible for the NRHP (including trails) and TCPs; Alternative A does not, and Alternative D specifies that important sites must have setting as an important aspect of their integrity. On a case-by-case basis, visual restrictions may exceed the 5-mile buffer to avoid adverse impacts to cultural resources, where structures are not screened from the resource by intervening topography.

Under Alternative B, the BLM manages portions of the town of Gebo and adjacent coal mining areas for preservation and interpretation, emphasizing a pedestrian trail rather than a road, thereby reducing access and associated indirect adverse impacts. This alternative also will provide comprehensive information about the site on the BLM website.

Finally, under Alternative B, the BLM limits motorized vehicle use to designated roads and trails on BLM-administered land along the Bighorn Slope, Bridger, Owl Creek, and Absaroka foothills to manage (minimize issues such as looting) for cultural and paleontological resources. Alternative B is similar to alternatives C and D in terms of travel restrictions. Alternative A, which does not restrict motorized vehicle use in these areas to designated roads and trails, provides less protection than Alternative B.

Alternative C

Surface Disturbance

Alternative C allows the most surface disturbance compared to the other alternatives, with the consequence that there would be the greatest potential for disturbance of cultural resources. As with the other alternatives, however, potential adverse impact to cultural resources would be limited through compliance with NHPA Section 106.

Because Alternative C places more emphasis on resource use, there are fewer restrictions on surface-disturbing activities for the protection of other resources (such as soil, water, biological resources, and special designations), so that although there is some additional protection for cultural resources, it is less than under the other alternatives. However, the potential for more surface-disturbing activities under Alternative C also may result in the identification of more cultural resources and their subsequent protection than under any of the other alternatives.

Resource Uses

Actions associated with resource exploration, development, and extraction are the most extensive and would have the greatest adverse impact on cultural resources under Alternative C. For leasable minerals, Alternative C applies an NSO restriction within ¼ mile and a CSU stipulation within 1 mile of important cultural sites. Similarly, there is a prohibition on mineral materials disposal within ¼ mile, or in view within 1 mile of these sites. Under Alternative C, adverse impacts to cultural resources from management of mineral leasing and mineral materials disposal would be similar to those under alternatives B and D, although to a greater degree because of the smaller area of restriction around important cultural sites. Impacts to cultural resources from locatable mineral development would be similar to those described for Alternative A, although to a greater degree because withdrawals are pursued over a smaller area (47,846 acres) than under the other alternatives.

The types of potential impacts due to land exchanges under Alternative C are the same as those for the other alternatives. The survey required for compliance with NHPA Section 106 in the case of either disposal or acquisition would result in a beneficial impact because of data that furthers understanding of cultural resources in the Planning Area. However, more area is identified for disposal (including special disposals and disposal for specific uses) and less area is identified for retention than under any other alternative, resulting in the greatest potential for adverse impacts.

Alternative C results in more road and trail construction, thereby accommodating more recreational and other uses in the Planning Area than under the other alternatives, exposing more cultural resources to impacts. For example, managing the Basin Gardens Play Area as open to cross-country motorized travel would expose known cultural sites to potential damage caused by off-trail motorized recreation.

Under Alternative C, the types of impacts associated with ROWs and corridors, renewable energy, and recreation would be the same as described for Alternative A, although the intensity would vary; impacts from CTTM would be the same as described for Alternative B. Alternative C is projected to result in the greatest extent of ROWs development, potentially providing the most potential survey acreage and the most access to previously remote cultural resources. The location of renewable energy development is subject to similar restrictions, but compliance with NHPA Section 106 may impose greater visual restrictions to reduce the visual impact of developments such as wind farms on all types of sites, including sites of importance to Native Americans, NRHP-listed and/or eligible sites, and trails. CTTM designations under Alternative C are similar to Alternative A except that a greater area is open to cross-country motorized travel (14,873 acres compared to 1,320 acres) and a smaller area is closed to travel, which may increase impacts in certain areas under this alternative.

Livestock grazing under Alternative C has the least restrictions and therefore the greatest potential adverse impact.

Special Designations

Under Alternative C, the BLM would not manage the Sheep Mountain, Little Mountain, and Upper Owl Creek areas as ACECs, removing any beneficial impacts to cultural resources from the application of restrictions on surface-disturbing activities specific to these special designations.

Resources

Under Alternative C, management for resources (e.g., soils and special status species) is less restrictive than under the other alternatives, which may result in the greatest impact on cultural resources by increasing resource use and the potential for degradation of cultural resources.

Impacts from fire and fuels management and vegetative treatments would be similar to those for alternatives A and D, although there is greater disturbance from prescribed fire under Alternative C than the other alternatives. The same relation is true for forest, woodlands, and forest products.

Wild horse management under Alternative C is similar to alternatives A and D, and applies fewer recreational restrictions that allow more access to HMAs than under Alternative B. Management under this alternative may result in greater access to remote areas, which may put cultural resources at increased risk than under Alternative B.

Proactive Management

Proactive management under Alternative C is closer to that under Alternative B than under Alternative A, reflecting current understanding of the importance of cultural resources and the potential impacts of other management actions. Proactive measures include further exploration of the Hanson site and nearby deposits, although Alternative C does not seek World Heritage nomination. Alternative C also emphasizes management of rock art and other archeological sites for research and interpretation, but imposes a smaller buffer zone than alternatives B or D, avoiding ROW authorizations in view within ¼ mile of important cultural sites where integrity of setting is a contributing element of NRHP significance, except within designated utility corridors. As previously mentioned, management of mineral leasing and mineral materials disposal under Alternative C results in smaller buffers than under alternatives B and D. Alternative C imposes visual restrictions, depending on the topography, within 5 miles of sites eligible for the NRHP and TCPs, and specifies avoidance/mitigation areas (in contrast to the exclusion areas under Alternative B), unless structures are screened from the site by intervening topography.

Under Alternative C, the BLM manages portions of the town of Gebo similar to alternatives A and D. Alternative C also emphasizes interpretation of historic oil and gas fields, providing interpretive signs in safe viewing areas, which would increase beneficial impacts to these historic resources compared to alternatives A or B. Alternative C emphasizes implementation of projects for the investment of maximum public recreation and access to cultural sites, subject to consultation and required resources protection, in contrast to Alternative B, which stresses resources protection. Overall, this may result in greater adverse impacts to cultural sites in relation to other alternatives. As with Alternative B, Alternative C would restrict motorized vehicle use to designated roads and trails on BLM-administered land along the Bighorn Slope, Bridger, Owl Creek, and Absaroka foothills to minimize issues such as looting.

Alternative D

Surface Disturbance

Although Alternative D allows more surface disturbance than alternatives A or B, it results in approximately half the disturbance of Alternative C (Appendix T); there is more potential to disturb cultural resources under this alternative than under alternatives A or B, but considerably less than under Alternative C. As with the other alternatives, adverse impacts to historic properties would be limited through BLM compliance with NHPA Section 106.

Restrictions on surface-disturbing activities for the protection of other resources (such as soil, water, biological resources, and special designations) would provide additional protection for cultural resources on a level overall greater than under Alternative C, and similar to that under alternatives A and B.

Resource Uses

Impacts from resource exploration, development, and extraction under Alternative D would be similar to impacts under alternatives A and C. Restrictions on mineral leasing and mineral materials disposal are more stringent than under Alternative C, but less restrictive than Alternative B in relation to determining the importance of setting and the use of BMPs to avoid or mitigate adverse impacts. As with the other alternatives, withdrawals would benefit cultural resources by prohibiting mineral activities that may degrade or destroy resources. Under Alternative D, withdrawals would be less than under all other alternatives except Alternative C.

Under Alternative D, beneficial and adverse impacts from land exchanges are the same as for other alternatives, with beneficial impacts resulting from information gathered through compliance with Section 106 and adverse impacts resulting from the loss of mandatory compliance with NHPA once the land has left public ownership. Alternative D allows disposal on more land than Alternative B, but less than alternatives A and C; the adverse impacts from disposal under Alternative D also are less than under alternatives A and C and more than under Alternative B.

Linear projects that include ROWs and corridors, renewable energy, CTTM, and recreation can result in similar adverse impacts. Potential adverse impacts from ROWs for road development are similar to impacts under Alternative A, but less than under Alternative C (Appendix T). Managing more area as ROW avoidance/mitigation or exclusion areas than under Alternative A may consolidate ROWs and limit adverse impacts to cultural resources to a greater extent. However, the affected area from open cross-country motorized travel under Alternative D is greater than under alternatives A or B, and approximately half that under Alternative C. CTTM designations under Alternative D are similar to Alternative A, but limiting off-road travel to within 300 feet of roads and trails would limit route proliferation and associated impacts to cultural resources. Additionally, management under Alternative D limits motorized vehicle use to existing roads and trails along the Bighorn Slope, Bridger, Owl Creek and Absaroka foothills. As for alternatives B and C, management of these areas is designed to minimize looting and facilitate management of cultural resources; however, management of motorized travel in these areas under Alternative D is less restrictive than under alternatives B and C and would result in fewer beneficial impacts to cultural resources.

Under Alternative D, impacts from livestock grazing would be similar to those under Alternative A, with management focused on maximizing multiple use while requiring buffer zones and managing livestock grazing to support other resource uses. Furthermore, Alternative D would mitigate new resource uses to minimize or avoid conflicts with livestock grazing where appropriate. Alternative D presents more potential for adverse impacts than Alternative B because of the much smaller area closed to livestock grazing and greater reliance on case-by-case evaluations of impacts.

Special Designations

As for Alternative A, under Alternative D, the BLM would manage the Sheep Mountain Anticline, Little Mountain, and Upper Owl Creek areas as ACECs for their cultural values (among other values), and would manage the Little Mountain ACEC expansion area discussed for Alternative B as the Craig Thomas Little Mountain SMA. Unlike Alternative B, Alternative D would not expand the Carter Mountain ACEC. Management of these areas as ACECs or SMAs provides additional protection for cultural resources and reduces the potential for adverse impacts. Under Alternative D, the BLM designates 52, 485 acres as Wild Lands and manages them to maintain their wilderness characteristics. Similar to Alternative B, this management would benefit cultural resources by limiting access and travel, imposing more restrictive VRM, and limiting minerals leasing. Adverse impacts to cultural resources would result from restrictions on the excavation of cultural sites in Wild Lands.

Resources

Fire and fuels management under Alternative D is similar to that under Alternative A and provides fewer restrictions than Alternative B. Prescribed fire would be implemented on approximately 40,000 acres in the Planning Area over the life of the plan.

Wild horse management under Alternative D is similar to that proposed under Alternative B. Alternative D promotes public viewing and education, similar to Alternative C. However, compared to Alternative C, Alternative D limits access and SRPs to some areas, providing additional protection to remote areas that may contain significant cultural resources.

Proactive Management

As with alternatives B and C, Alternative D proactively recognizes the current understanding of cultural resources management practices. Proactive measures are a mix of alternatives A, B and C. The BLM would investigate and nominate the Hansen site as a National Historic Landmark, but would not pursue World Heritage nomination. Rock art and other prehistoric and historic sites and districts are managed for scientific, public and sociocultural use, and research and preservation for future study and use. Known important cultural sites are protected from surface-disturbing activities. For resources where setting is important to the site's integrity, the site's foreground is to be avoided (in contrast to prohibited under Alternative B) with buffers that may be up to 3 miles wide. This buffer is smaller than the buffer under Alternative B, but larger than the buffers under alternatives A and C, and applies to mineral leasing and mineral materials disposal actions for all site types (e.g., trails, sites eligible for the NRHP, and TCP). In addition, implementing BMPs would avoid or mitigate adverse effects.

Similar to Alternative B, Alternative D implements projects for the investment of maximum cultural resource protection, but is more similar to Alternative C in its management of historic resources in oil and gas fields, including the installation of interpretive signs. Under Alternative D, the BLM would manage the town of Gebo and adjacent coal mining areas as it would under Alternative A.

4.5.2 Paleontological Resources

The widespread presence of paleontological resources throughout the Planning Area and their close spatial association with extractive resources present a number of management challenges. Adverse impacts to paleontological resources result from management actions that damage or destroy fossils or their context. Any surface-disturbing activities in an area that contain fossils may result in adverse impacts through disturbance of important paleontological resources. Direct impacts to paleontological resources from RMP alternatives may result from actions that physically alter, damage, or destroy fossils or their context. It is important to remember that trace fossils, exemplified by dinosaur tracks such as those at the Red Gulch Track site, are as important as body fossils, and can also be affected by surface-disturbing activities. In fact, the rarity of trace fossils underscores the potential adverse impact from surface disturbance. Indirect impacts may arise as a result of ancillary actions, such as when a construction road provides improved access to sensitive areas, possibly resulting in increased vandalism or unauthorized or unintentional collecting. Paradoxically, the same actions that can result in direct or indirect adverse impacts from increased public access and awareness may also have beneficial impacts. The discovery of previously unknown deposits or the facilitation of data collection, preservation, or public education are possible beneficial impacts.

There is little difference between short-term and long-term impacts to paleontological resources; once the resource is disturbed, it cannot be restored because it is unique and not renewable. However, the situation is more complicated for indirect impacts. Because some paleontological resources are in

inaccessible areas, it is possible that a short-term, direct impact would indirectly lead to a long-term beneficial impact. For example, a road that improves access but leads to vandalism in the short term may also, in the long term, make study of the resource more feasible. Similarly, surface disturbance that exposes or destroys part of an important deposit would simultaneously bring new resources to light, thereby enhancing scientific knowledge.

4.5.2.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Vertebrate and other scientifically important paleontological resources will continue to be found in the Planning Area.
- Adverse impacts to paleontological resources occur from physical damage or destruction of fossils, from loss of related scientific data, including context and stratigraphic control, and potentially due to transfer from public ownership.
- Adverse impacts to paleontological resources from surface-disturbing activities occur primarily at the time of initial surface disturbance. Therefore, it is valid to use the projected numbers for short-term surface disturbance to quantify impacts to paleontological resources. Erosion resulting from long-term surface disturbance also can adversely impact paleontological resources, but generally not to the extent of short-term surface disturbance.
- Development activities over the life of the RMP are anticipated to be similar in intensity to the intensity represented by surface-disturbance acres identified in Appendix T.
- Inventories required before surface disturbance in high-probability areas would result in the identification and evaluation of previously undiscovered resources, which the BLM would then manage accordingly. Surface-disturbing and other disruptive activities also may dislocate or damage paleontological resources that were not discovered before surface disturbance (i.e., unanticipated discoveries). In some cases, surface-disturbing activities, along with avoidance or full mitigation, can benefit the resource.
- The number and types of paleontological resources that could be affected by various actions directly correlate to the degree, nature, and quantity of surface-disturbing activities in the Planning Area.
- Paleontological resources at the surface are most typically associated with bedrock exposures. Areas of deep soils, alluvium, or colluvium only rarely contain scientifically significant fossils. Therefore, the main areas of concern for impacts to paleontological resources are where fossil-bearing bedrock is at or near the surface, such as badlands, along structural uplifts, hill slopes, or in areas with thin soils over bedrock.

4.5.2.2 Summary of Impacts by Alternative

The principle direct impacts to paleontological resources would result from surface-disturbing activities, while indirect adverse impacts would result from increased access to important paleontological locations that lead to overuse, increased legal and illegal collecting, and vandalism. Conversely, all of these adverse impacts may also lead to beneficial impacts as new deposits are located, educational opportunities arise, and research programs are instituted. Proactive paleontological resource management actions result in beneficial impacts across all alternatives. Furthermore, compliance with the Paleontological Resources Protection Act (PRPA) and the BLM recently issued PRPA guidance would limit adverse impacts and maximize beneficial impacts. The PRPA provides for criminal and civil penalties for theft and vandalism of fossils on public land. Other resource uses are, by law, required to

minimize impacts to paleontological resources from vandalism and theft, and maintain the confidentiality of resource locations.

Alternative B, by designating nine ACECs (116,116 acres) for paleontological values and subjecting the least acreage to surface-disturbing activities, would have the least adverse impacts and most resource protection compared to the other alternatives. Alternative C provides the least protection and the greatest exposure to direct impacts from surface-disturbing activities, but may result in more identification of paleontological localities due to increased resource use. In terms of potential impacts, management under Alternative D falls between management under alternatives A and B, in that Alternative D employs a less proactive management approach than Alternative B but a similar approach to casual use and education.

4.5.2.3 Detailed Analysis of Alternatives

Allowable uses and management actions that impact paleontological resources include all surface-disturbing activities, changes in ownership, visitor accessibility, motorized vehicle use, and proactive paleontological resource management actions.

Impacts Common to All Alternatives

Potential impacts to paleontological resources as a result of other resource management actions are similar, although the intensity varies across alternatives. For all alternatives, impacts may stem from any surface-disturbing activity in an area where fossils are known or found to be present.

Similarly, paleontological resources would experience beneficial impacts from proactive management actions common to all alternatives. Although the degree of protection may vary by alternative, the goals of such management are the same for each alternative. For example, positive interaction with the public to prevent illegal activities and project reviews to avoid scientifically important paleontological resource sites are management priorities that result in beneficial impacts. The latter action will allow the avoidance of surface-disturbing activities that could damage or destroy significant paleontological values on BLM-administered land, including resources listed in National Park Service inventories of possible National Natural Landmarks. Other proactive, beneficial impacts across all alternatives come from balancing restrictions on access to newly discovered paleontological resources with opportunities for the public to collect fossils in a limited, recreational manner. This is accomplished through the management of scientifically significant paleontological resources for scientific and public use.

The recently enacted PRPA provides a new level of protection for paleontological resources (see Section 3.5.2 *Paleontological Resources* in Chapter 3). The interface of this law with BLM guidance is under development, and it remains to be seen specifically how it will affect the management of paleontological resources under BLM jurisdiction.

Brown/Howe Dinosaur Area ACEC, which the BLM manages for its paleontological values, appears under all alternatives. The management of and impacts from the management of this and other ACECs that include paleontological resources is mentioned in this section, but discussed in detail in Section 4.7.1 *Areas of Critical Environmental Concern*.

Alternative A

Surface Disturbance

Under Alternative A, surface-disturbing activities may result in impacts to paleontological resources. The BLM anticipates that impacts to paleontological resources from surface disturbance under

Alternative A (see Appendix T) would be primarily adverse. However, required resource identification through on-the-ground survey of PFYC 5 and case-by-case for PFYC 4 before surface-disturbing activity will identify resources, and may mitigate adverse impacts, possibly resulting in data collection or preservation of paleontological resources, which would result in a beneficial impact. Once a paleontological locality is identified, Alternative A requires a 50-foot-wide buffer to preclude any surface-disturbing activities from damaging the locality.

Restrictions on surface-disturbing activities for the protection of other resources (such as soil, water, biological resources, and special designations) under Alternative A may provide additional protection for paleontological resources, because management that limits the potential for disturbance would result in beneficial impacts.

Resource Uses

Exploration for and development of locatable minerals, leasable minerals, and mineral materials would result in adverse impacts. Impacts would be direct, if exploration for or development led to disturbance of the paleontological resource, or indirect, if a road or other associated activity improved access to an otherwise inaccessible locale. However, mineral exploration or development activity also would lead to beneficial impacts, because discovery, improved access, and avoidance would eventually result in the opportunity to study previously unknown fossils and to educate the public.

Management actions associated with lands and realty would result in adverse and beneficial impacts. The BLM anticipates potential beneficial impacts under Alternative A, wherein the acquisition and retention of lands with significant paleontological resources is to be considered, but is not pursued as an active management strategy. However, if lands with important paleontological resources are disposed of and leave federal management, there may be adverse impacts because these areas would no longer be subject to the PRPA and other federal laws and regulations designed to protect these resources.

Impacts from linear resource uses (e.g., ROWs, corridors, and road development) and renewable energy development are similar, and may result in direct adverse impacts from surface disturbance associated with development. Indirect impacts arise from increased accessibility and resulting increased recreation use provided by the corridors and associated development. These activities may result in beneficial impacts if the development results in the discovery of resources or research and educational opportunities.

Off-road motorized vehicle use on public lands has the potential to directly and indirectly affect paleontological resources. Direct impacts occur when vehicles run over exposed fossils on a trail; indirect impacts result from accelerated erosion and degradation due to exposure. In addition, off-road motorized vehicle use enables access to remote paleontological localities, and would increase opportunities for theft and vandalism. While there may be adverse impacts due to off-road or inappropriate use of motorized vehicles under any circumstances, restricting motorized vehicle use in certain areas would provide some protection for sensitive resources. The BLM anticipates that Alternative A would result in disturbance associated with motorized vehicle use, which would have the potential to adversely affect paleontological resources in areas such as the Bighorn Slope, Bridger, Owl Creek, and Absaroka foothills. Recreation would result in adverse and beneficial impacts to paleontological resources. Increased use of the Planning Area and an increase in the number of recreational collection permits would increase the potential for damage to paleontological resources; an increase in opportunities to improve education and paleontological interpretation would benefit the resources.

Special Designations

Under Alternative A, the BLM manages four ACECs, including the Brown/Howe Dinosaur Area ACEC, for their paleontological values. For the Little Mountain ACEC, management would emphasize avoidance of sensitive areas, provide some restrictions for mineral development, and pursue withdrawal from appropriation under the mining laws in limited areas within the ACEC. Under Alternative A, the BLM also manages the Red Gulch Dinosaur Tracksite and Big Cedar Ridge areas as ACECs, limiting surface disturbance and providing other protections to paleontological resources in these areas.

Resources

The BLM anticipates surface disturbance associated with prescribed fire and mechanical fuels treatment under Alternative A. Actions related to fire and fuels management may result in adverse impacts to paleontological resources. Construction of fire breaks can cause surface disturbance, which may damage or destroy important fossils. However, there may also be beneficial impacts if the disturbance exposes previously unknown resources or improves access for study. Surface disturbance related to fire and fuels management would result in fewer impacts to paleontological resources than other types of surface disturbance, because it is less likely to penetrate deeply into strata that contain important resources.

Proactive Management

Under Alternative A, management actions that aid in the identification and preservation of scientifically important fossils include attachment of standard Paleontological Resources Protection Stipulations to surface-disturbing activities on PFYC 3, 4, or 5; retention and acquisition of lands for significant paleontological resources (although this is on a case-by-case basis); and development of additional interpretive sites. Under Alternative A, development of interpretive sites at informational locations is on a case-by-case basis. Surface disturbance associated with development of the interpretive site may result in adverse impacts to the paleontological resources. However, the public would benefit from development of this educational exhibit. Potential impacts from this management illustrate the dichotomy between the adverse impacts of direct disturbance and increased access, and the beneficial impacts of education and discovery.

Alternative A also includes several management actions, all of which are applied on a case-by-case basis, designed to protect paleontological values from actions not related to resource use, such as theft and vandalism. These management actions include closing areas with vertebrate or other scientifically significant paleontological resources at risk for damage from illegal activities and implementing on-the-ground surveys before surface disturbance or land disposal actions for all PFYC 5 formations and PFYC 4 formations on a case-by-case basis.

Alternative B

Surface Disturbance

Alternative B includes the least acreage subject to surface-disturbing activities. Therefore, surface disturbance under this alternative would result in the least impact to paleontological resources. Similar to Alternative A, impacts to paleontological resources from surface disturbance projected for Alternative B may be primarily adverse. However, an increase in resource identification due to on-the-ground surveys of PFYC 3 through 5 before surface-disturbing activity would result in a beneficial impact because it would identify more resources, and may mitigate adverse impacts or result in data collection and preservation of paleontological resources. Alternative B also requires a 100-foot–wide buffer

around paleontological localities to preclude any surface-disturbing activities, providing greater protection than the other alternatives.

Alternative B includes the most restrictions on surface-disturbing activities for the protection of other resources, thereby resulting in more beneficial impacts than the other alternatives.

Resource Uses

As with Alternative A, exploration for and development of locatable minerals, leasable minerals, and mineral materials are likely to result in direct and indirect adverse impacts from disturbance and improved access. However, because Alternative B would result in less surface disturbance associated with minerals development, it also would result in fewer impacts to paleontological resources compared to the other alternatives. Making greater sage-grouse Key Habitat Areas administratively unavailable to mineral leasing would result in indirect beneficial impacts by limiting the potential degradation of paleontological resources in these areas.

Management actions associated with lands and realty would result in adverse and beneficial impacts. The greatest benefit would result from alternatives B and D, under which the acquisition and retention of lands with significant paleontological resources is to be actively pursued. The least benefit would be under Alternative A, under which acquisition and retention of lands with significant paleontological resources is only considered and, lastly, under Alternative C, under which no acquisition of private lands is planned.

Impacts from ROW-related actions and renewable-energy resource development would be fewer under Alternative B than under the other alternatives. Impacts from trails management and recreation under Alternative B would be similar to those under Alternative A, but to a lesser degree. Alternative B is projected to result in more surface disturbance from cross-country motorized travel in small, localized areas (Appendix T), but limits motorized vehicle use to designated roads and trails and closes more area to motorized vehicle use in the Planning Area. Limiting motorized vehicle use to designated roads and trails in the Bighorn Slope, Bridger, Owl Creek, and Absaroka foothills, and the Absaroka Front Management Area (partially closed to motorized vehicle use) would reduce potential disturbance and restrict access, thus decreasing the risk of looting. As with the other alternatives, the potential for beneficial impacts through discovery and subsequent research and educational opportunities would remain.

Special Designations

Alternative B designates eight ACECs for paleontological values and increases the size of several existing ACECs. For the Little Mountain ACEC, management under Alternative B is similar to Alternative A, with the addition of an expansion area. The Brown/Howe Dinosaur Area ACEC is maintained across all alternatives, but under Alternative B it would be administratively unavailable for mineral leasing, managed as ROW avoidance/mitigation, and the BLM pursues a withdrawal from appropriations under the mining laws. For the Red Gulch Dinosaur Tracksite and Big Cedar Ridge ACECs, management under Alternative B would be the same as under Alternative A. Alternative B also would add four ACECs with paleontological values – Clarks Fork Basin/Polecat Bench West Paleontological Area, McCullough Peaks South Paleontological Area, Foster Gulch Paleontological Area, and Rainbow Canyon Paleontological Area. Section 4.7.1 *Areas of Critical Environmental Concern* further discusses the management of and impacts from ACECs.

Resources

Actions related to fire and fuels management are anticipated to have an adverse impact on paleontological resources. Projected impacts are less under Alternative B than under the other alternatives.

Proactive Management

Proactive management under Alternative B provides the most protection for paleontological resources of any alternative. This management includes protection for PFYC below 4 and 5, larger buffer zones around important paleontological discoveries and sites, and prohibitions on surface disturbance. Alternative B also provides more protection for vertebrate or other scientifically significant paleontological values from actions related to non-resource use (e.g., theft and vandalism) compared to the other alternatives through the use of measures such as increased law enforcement and resource specialist presence in areas of high resource values and posting additional signs warning against illegal collection. Alternative B also includes management actions requiring the BLM to pursue opportunities to acquire private lands with vertebrate or other scientifically significant paleontological resources, actively solicit paleontological research, and sponsor data sharing and symposia. While management under Alternative B designates areas for casual use and collection of certain fossil types, it also seeks to minimize the development of interpretive sites in the Planning Area.

Alternative C

Surface Disturbance

The BLM anticipates that Alternative C would result in the most short-term and long-term surface disturbance. Therefore, this alternative would result in the most adverse impacts to paleontological resources of any alternative. Projected impacts to paleontological resources from surface disturbance under Alternative C (Appendix T) are anticipated to be similar to those described for Alternative B, although to a greater extent and intensity. The BLM requires on-the-ground surveys before it approves surface-disturbing activities, and monitoring of surface-disturbing activities in PFYC 5 formations, which would provide some mitigation of adverse impacts and may result in beneficial data collection or the preservation of paleontological resources.

As with the other alternatives, restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations) would protect paleontological resources, although the more limited nature of these protections under Alternative C would result in the least additional protection of any alternative.

Resource Uses

Impact from the exploration for and development of locatable minerals, leasable minerals and mineral materials would be greater under Alternative C than the other alternatives due to more projected surface disturbance. Monitoring is only provided for actions in PFYC 5, and standard Paleontological Resources Protection Stipulations are only attached to surface-disturbing activities in PFYC 4 or 5. Once a paleontological locality is identified, Alternative C requires a 50-foot-wide buffer, as does Alternative A. As with the other alternatives, resource use may also have a beneficial impact if discovery, improved access, and avoidance lead to the opportunity to study previously unknown fossils and to educate the public.

Management actions associated with lands and realty would result in adverse and beneficial impacts. The potential beneficial impact is similar to that under Alternative B, under which the BLM retains lands

with important paleontological values. However, under Alternative C, there would be no beneficial impacts from acquisition of lands with significant paleontological resources, as described for Alternative B.

Impacts from linear resource uses such as ROWs, corridors, and roads, and from renewable-energy resource development, would be greatest under Alternative C. Management under Alternative C includes relatively few restrictions on ROW development and associated surface-disturbing activities, increasing the chance of direct and indirect impacts to paleontological resources. However, although the area affected by this management is larger under Alternative C, it is not likely that the corresponding beneficial impact also would be larger, because the magnitude of the increased use would probably not be balanced by a corresponding beneficial gain in knowledge and resource discovery. A similar adverse-to-beneficial impact imbalance would occur in the management of recreation and motorized vehicle use, because the magnitude of the increase in visits and traffic may outweigh the increase in knowledge gained. Restricting motorized vehicle use to designated roads and trails in the Bighorn Slope, Bridger, Owl Creek, and Absaroka foothills and the Absaroka Front Management Area would result in similar impacts to those under Alternative B.

Special Designations

Special designations under Alternative C would result in the least overall beneficial impact to paleontological resources. Alternative C does not designate any ACECs with paleontological values other than the Brown/Howe Dinosaur ACEC, which is designated under all alternatives. Paleontological resources in the Little Mountain, Red Gulch Dinosaur Tracksite, Big Cedar Ridge and other areas designated as ACECs under the other alternatives would be at a higher risk of degradation under Alternative C.

Resources

The area potentially affect by management of fire and fuels under Alternative C is projected to be twice that of Alternative A, and therefore likely to result in more adverse impacts to paleontological resources. Although beneficial impacts also are possible, the increased potential for adverse impacts would outweigh the benefits.

Proactive Management

Under Alternative C, some current management practices would continue. However, focus would shift to reactive investigations, such as implementation of the PFYC system for permits exceeding 5 acres and survey and monitoring in PFYC 5 formations. The BLM attaches Standard Paleontological Resources Protection Stipulations to authorization of surface-disturbing activities only for PFYC 4 or 5. Protection of significant paleontological values from theft and vandalism would be the same as for Alternative A, resulting in similar beneficial impacts. As for alternatives B and D, under Alternative C the BLM retains public ownership of lands with important paleontological values, but does not seek to acquire additional lands with important fossils. Under Alternative C, the BLM actively develops paleontological interpretive sites, resulting in impacts similar to those described for Alternative A, although to a greater degree.

Alternative D

Surface Disturbance

The BLM anticipates that Alternative D would result in slightly more surface disturbance and associated adverse and beneficial impacts to paleontological resources than Alternative A. However, the amount of surface disturbance varies by resource use, and certain resource uses that adversely affect

paleontological resources (e.g., mineral development) would be similar to or disturb less area than Alternative A. New roads and trails, primarily associated with user-pioneered routes in areas designated as open to cross-country motorized travel, are anticipated to result in the largest increase in surface disturbance under Alternative D. Before surface-disturbing activity, on-the-ground surveys of PFYC 3 through 5 will be performed on a case-by-case basis, which would identify resources and may mitigate adverse impacts. This management also may result in beneficial impacts to data collection or preservation of paleontological resources, which would result in a beneficial impact. Surface-disturbing activities are allowed within at least 100 feet of the outer edge of a paleontological locality if the impacts can be adequately mitigated, in contrast to the other alternatives, which prohibit surface-disturbing activity within a certain buffer width of a paleontological locality.

Resource Uses

Minerals development under Alternative D would result in impacts similar to but slightly less than Alternative A, resulting in fewer impacts to paleontological resources. Limitations on mineral leasing in Key Habitat Areas for species such as greater sage-grouse would result in indirect beneficial impacts by limiting potential degradation of paleontological resources in these areas.

Under Alternative D, management actions associated with lands and realty are the same as under Alternative B, including the retention of BLM-administered land with significant paleontological values and the pursuit of acquisition of private lands with such resources. Impacts from ROW-related actions and renewable-energy resource development would be similar to those described for Alternative A, though to a lesser degree.

Impacts from trails management and recreation under Alternative D would be more than under alternatives A and B, but less than under Alternative C. Alternative D is projected to result in more surface disturbance from cross-country motorized travel in small, localized areas than alternatives A and B (Appendix T). CTTM designations under Alternative D are similar to those under Alternative A, but limiting off-road travel for big-game retrieval to within 300 feet of roads would limit route proliferation and the associated impacts to paleontological resources. As with Alternative B, limiting motorized vehicle use to designated roads and trails in the Bighorn Slope, Bridger, Owl Creek, and Absaroka foothills, and the Absaroka Front Management Area (partially closed to motorized vehicle use) would limit potential disturbance and restrict access to decrease the risk of looting. As with the other alternatives, there would be a potential under Alternative D for beneficial impacts through discovery and subsequent research and educational opportunities.

Special Designations

Under Alternative D, the BLM would manage four areas as ACECs for paleontological values. For the Little Mountain ACEC, management is similar to Alternative A, but with portions managed as administratively unavailable to oil and gas leasing. The BLM would manage the Brown/Howe Dinosaur Area ACEC under all alternatives, but under Alternative D would manage it as VRM Class III, allow ROW authorizations and other surface-disturbing activities following on-the-ground surveys before approving such activities or land disposal activities, and monitor surface-disturbing activities for PFYC 3 through 5 formations. For the Red Gulch Dinosaur Tracksite and Big Cedar Ridge ACECs, management under Alternative D is the same as under Alternative A. The Rainbow Canyon Paleontological Area, proposed under Alternative B, is not managed under Alternative D, and the beneficial impacts from BLM management described for Alternative B would not occur. Three areas proposed under Alternative B – Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch Paleontological Area, and McCullough Peaks South Paleontological Area – are not designated as ACECs, but part of all three of these areas lie within the proposed PETM ACEC, which is unique to Alternative D. Section 4.7.1 *Areas of*

Critical Environmental Concern further discusses management of and impacts from these special designations.

Resources

Under Alternative D, actions related to fire and fuels management would result in similar adverse impacts to paleontological resources as for Alternative A.

Proactive Management

Proactive management under Alternative D most resembles Alternative A, with fewer proactive actions than Alternative B. Differences from Alternative A include requiring an on-the-ground survey before approving surface-disturbing activities for PFYC 3, 4, and 5 on a case-by-case basis; allowing surface-disturbing activities within at least a 100-foot-wide buffer of the outer edge of a paleontological locality as long as impacts can be adequately mitigated; encouraging research (in contrast to providing opportunities for research).

4.5.3 Visual Resources

Adverse impacts result from projects that create visual contrast with the natural form, line, color, or texture of the landscape to the extent that it degrades the visual values of an area, which are documented in the visual resource inventory (see Chapter 3). The visual values recorded in the visual inventory form the baseline assessment of the quality of the visual landscape against which impacts from changes in management proposed under the management alternatives are measured. Adverse impacts can occur regardless of whether a resource development project meets an established visual objective. Adverse impacts are not limited to human-caused activity, as wildland fire or other natural phenomenon also can adversely affect visual values. If resource development creates little or no contrast with the natural form, line, color, and texture of the landscape in the area of development, little or no impact would result. Human activity may, in certain cases, create beneficial impacts to visual resources if the activity adds visual variety that is in harmony with the natural landscape.

Direct impacts to visual resources occur if the visual values of the landscape are diminished or enhanced through the creation of natural or human-caused contrast. Indirect impacts relate to the management of other resource values, in which specific actions may limit or increase visual contrast on the landscape. Actions on lands not administered by the BLM (regardless of ownership) can impact the visual values of the adjacent public lands.

For purposes of this analysis, short-term impacts are those that last up to 5 years before the visual impact is mitigated or removed. Long-term impacts are any impacts that affect visual resources for longer than 5 years, such as visual intrusions associated with the construction of wind turbines.

4.5.3.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- The BLM will manage public lands in a manner that conforms to visual objectives established in this RMP. Resource development proposals in areas with VRM Class I, II, or III visual objectives will be held to those standards.
- The Class I objective is to preserve the existing character of the landscape. Projects in Class I areas must not attract attention.
- The Class II objective is to maintain the existing character of the landscape. Projects may be seen, but may not attract the attention of the casual observer.

- The Class III objective is to partially maintain the existing character of the landscape. Projects may be seen and attract attention, but must not dominate the attention of the casual observer.
- The Class IV objective provides for major changes to the landscape. Projects may be seen and be the major focus of attention for the casual observer. Class IV allows for substantial changes to the form, line, color, and texture of the landscape.
- The visual inventory classes (I, II, III, IV) are used to represent the relative value of visual resources in the Planning Area; these classes are based on an areas scenic quality, sensitivity level, and distance zone (see Chapter 3 for a list of the criteria used to rate these three factors). Visual inventory Classes I and II are applied to the most visually valuable areas, Class III represents somewhat lesser value areas, and Class IV represents the least valued areas (due to low scenic quality or substantial development). In the Planning Area, visual inventory Class I is generally assigned to WSAs.
- Adverse impacts would occur where an area's visual management is less protective than warranted by its inventory class. For example, adverse impacts would occur if an inventory Class II area (i.e., a highly visually valuable area) was managed as VRM Class IV (i.e., managed to allow for a major modifications of the existing landscape). Conversely, beneficial impacts would occur in areas where the management applied is consistent with or more restrictive than warranted by the inventory class. For example, a beneficial impact would occur where a visual inventory Class III area (i.e., an area of moderate visual value) is managed as VRM Class II (i.e., managed to allow for minimal visual contrast). Generally, any activity that creates new visual contrast is considered adverse; however, contrast that is consistent with the area's visual inventory class is generally considered to have a smaller adverse impact.
- Inconsistency between an areas visual values and its management, particularly where management is less restrictive, can degrade or improve an areas visual values to the point that it shifts visual inventory classes. For example, a visual inventory Class II area managed as VRM Class IV may become altered by human actions to the point that it takes on the lower visual values of a visual inventory Class IV area.

4.5.3.2 Summary of Impacts by Alternative

To manage visual values, each alternative applies VRM Classes (I, II, III, IV) to the Planning Area; adverse impacts would primarily result where an area's VRM Class is less protective than warranted by its visual inventory class (e.g., a visual inventory Class II, a highly visually valuable area, is managed as VRM Class IV, which allows for a major modification of the landscape) and beneficial impacts would result from areas where the VRM Class applied is consistent with or more restrictive than the area's visual inventory class (e.g., a visual inventory Class III area managed as VRM Class III or Class II). Under all alternatives, traditional resource uses and development will continue, allowing varying degrees of development and resulting in new visual contrast. Alternatives A and C, would be the least protective of visual values as both alternatives manage substantial portions of the Planning Area below their visual inventory class, including substantial areas of visual inventory Class II managed as VRM Classes III and IV (see Table 4-11). However, compared to Alternative C, Alternative A manages a larger portion of lower visual value visual inventory Class IV areas a more restrictive VRM Class III, which would result in greater beneficial impacts in those areas. Alternative B is most protective of visual values, as it would manage almost the entire Planning Area consistent with or more restrictive than the classification determined from the visual inventory (see Table 4-11). Alternative B would therefore be the most effective at maintaining the existing, primarily undeveloped, character of the landscape; managing areas of lower visual value under more restrictive management may also lead to an enhancement of these areas, primarily over the long

term. Under Alternative D, VRM closely matches VRM Classes to their corresponding visual inventory Classes (i.e., most visual inventory Class II areas are managed as VRM Class II); this management would thereby be aimed at retaining the visual values identified during the visual inventory.

Table 4-11. Acres of Visual Resource Inventory Classes in Visual Resource Management Classes by Alternative

VRM Class and Acreage	Visual Resource Inventory Class Acreage[1,2]			
	Class I	Class II	Class III	Class IV
Alternative A				
Class I (141,110)	140,932	178	0	0
Class II (339,205)	21	286,680	32,996	19,142
Class III (890,353)	0	313,355	171,540	405,446
Class IV (1,814,373)	0	381,454	181,148	1,255,931
Alternative B				
Class I (154,343)	140,946	13,300	95	0
Class II (1,782,843)	8	964,733	366,551	455,744
Class III (393,887)	0	3,922	4,315	385,650
Class IV (858,162)	0	4	19,023	843,344
Alternative C				
Class I (140,958)	140,946	12	0	0
Class II (330,020)	0	318,836	7,549	3,611
Class III (511,801)	8	238,058	105,812	172,139
Class IV (2,202,239)	0	425,054	272,405	1,504,769
Alternative D				
Class I (140,954)	140,954	0	0	0
Class II (638,929)	0	545,397	74,057	19,077
Class III (836,361)	0	346,013	270,389	224,176
Class IV (1,573,357)	0	90,550	45,539	1,441,486

Source: BLM 2009a
VRM Visual Resource Management
[1] The inventory classes provide the baseline for visual resources in the Planning Area and are the indicator of visual values against which the impacts from VRM under the various management alternatives are measured. Inventory and visual resource management class acreages shown are for BLM-administered surface.
[2] The BLM does not assign surface lands managed by another federal agency, such as the National Park Service, to a visual resource management class, and these areas are therefore not included in the by-alternative comparison in this table.

4.5.3.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

There would be adverse impacts to visual resources under each alternative. However, the intensity and extent of impacts would vary. Impacts to visual resources would occur where VRM is inconsistent with an area's visual inventory class rating, or where major visually impairing projects, such as wind farms or mining areas, located in areas with low VRM objectives (Class IV) negatively influence the scenic quality of areas managed to maintain scenic quality, such as Class I or II areas. To a lesser extent, any project that creates new visual contrast, regardless of whether that contrast is consistent with the area's visual values as identified in the visual inventory, would result in impacts. Under any of the alternative analyzed here, the major sources of visual contrast in the Planning Area would be from ongoing oil and gas development; renewable energy (wind) development; mining; fire, fuels, and vegetation management; and off-road motorized vehicle activities. Depending on the visual values of an area, varying degrees of visual contrast may be compatible with the landscape and can occur without being considered an adverse impact.

Energy development would cause surface disturbance and introduce facilities that create contrasts with the form, line, color, and texture in the landscape. The forms of tanks, wind turbines, and similar facilities, and earthwork would contrast with the natural form of the landscape. The lines created by roads, powerlines, and facilities would contrast with the natural lines in the landscape. Energy facilities would typically be a lighter color and have smoother surfaces than the surrounding landforms and vegetation, thus creating contrasts of color and texture. Implementing BMPs to reduce visual contrast with surroundings may mitigate potential adverse impacts to visual resources resulting from the development of energy and associated facilities. Through the design and placement of facilities in consideration of the surrounding environment, visual contrast can be reduced, although not completely eliminated.

Mining activity, particularly for locatable minerals, would result in new visual contrast on the landscape due to road construction and excavation. As mining proceeds, artificial forms such as spoil piles and excavation pits are created that contrast with the surrounding natural landscape. For example, locatable bentonite mining usually involves establishing temporary stockpiles of mined bentonite, which would be a much lighter color than the surrounding undisturbed landscape. Because locatable mineral development is not a discretionary activity, the BLM cannot enforce VRM restrictions; therefore, adverse impacts to high visual value areas can result, even when they are managed under more restrictive VRM Classes. Adverse impacts from locatable mineral development are most likely to occur on the 435,324 acres with known bentonite potential and the 142,577 acres with known gypsum potential.

The development of wind energy would result in substantial visual contrast over relatively large areas. Wind turbines can reach up to 500 feet in height and also add an element of movement that can attract the attention of viewers. In addition, changes to the characteristic landscape from wind farms are often greater than other types of development because they generally require multiple wind turbines in a concentrated area. Wind potential is typically greater at higher elevations and, consequently, in more visible and sensitive locales that experience greater and more constant wind speed. These characteristic of wind development mean that mitigating its visual contrast can be difficult. Highly visible areas (mountaintops and ridges) and areas with high visual value (generally visual inventory Class I and II areas) with high potential for wind-energy development, such as Rattlesnake Mountain, may be the most adversely affected by this type of development if the values consistent with their visual classification are not protected or mitigated. Mineral and renewable energy development would

produce both short- and long-term visual contrast on the landscape. Construction and staging activities are generally short-term, whereas the life of a mineral development or renewable energy project is either long-term (30 to 50 years, plus final reclamation) or permanent. Interim reclamation measures can reduce the degree of contrasting elements of long-term surface disturbance.

Motorized vehicle activity would further exhibit or create contrasting elements of line and color from roads and trails against the natural elements in the surrounding landscape. The exposed lighter-colored soil would contrast with the surrounding vegetation, which is usually a darker gray-green color. Unreclaimed surface disturbance from unauthorized motorized vehicle activity would be either short-term or long-term. There would likely be unauthorized use (e.g., cross-country motorized travel in areas with limited travel designations) under all alternatives, though restrictions and the use of travel management designations may limit the creation of additional roads and trails that would cause new visual contrast.

Fire, fuels, and vegetation management can remove or alter the structure and density of vegetation and affect visual resources. Wildland fires can create substantial visual contrast in the form of large burned areas that, depending on the visual value of an area, may result in short-term adverse impacts. However, reducing hazardous fuels to decrease the chance of stand-replacing fires and diversifying stand age and improving forest health would reduce the chance of more severe fires and their associated large burn areas. Fire suppression activities and vegetation management can change the natural line, color, form, and texture of vegetative communities and the introduction of new visual intrusions, such as access roads or fire lines and breaks. The new contrasts from most of these activities would be short-term in nature. Over the long term, visual contrast would diminish as vegetative communities regenerate.

Under all alternatives, the BLM would manage visual resources in accordance with VRM Class objectives (see the 'Methods and Assumptions' section above). Before authorizing land uses that may affect the visual values of the landscape, the BLM would consider how the land use would align with the VRM Class objective. For example, the BLM would allow surface-disturbing activities within VRM Class II areas if the contrasting visual elements from the actions can be minimized or eliminated. The BLM manages all WSA areas under VRM Class I objectives, resulting a minimal potential for adverse impacts to visual values in these areas. The size of the VRM Class areas vary by alternative, as discussed below.

Alternative A

Under Alternative A, the BLM manages 141,110 acres of BLM-administered surface as VRM Class I, 339,205 acres as VRM Class II, 890,353 acres as VRM Class III, and 1,814,373 acres as VRM Class IV. The objective of VRM Classes I and II (15 percent of BLM-administered surface) is to preserve or retain the existing character of the landscape. VRM Classes III and IV (85 percent of BLM-administered surface) would generally allow changes to the characteristic landscape, subject to some level of mitigation.

VRM under Alternative A is generally not consistent with the visual values (represented by the visual inventory classes) indentified in the visual resource inventory for the Planning Area, resulting in the potential for both adverse and beneficial impacts. As shown in Table 4-12, Alternative A manages substantial portions of the Planning Area at or above (i.e., less protective of visual values) their visual inventory Class, which would result in adverse impacts to visual values by potentially allowing the construction of contrasting elements (described below and under Impacts Common to All Alternatives) incompatible with these areas. The potential for adverse impacts would be greatest where visual inventory Class II and III areas are managed as VRM Class IV (381,454 acres and 181,148 acres, respectively), but would also occur in the 313,355 acres of visual inventory Class II managed as VRM Class III. As shown in Table 4-12, this alternative would also manage large portions of the Planning Area

with High Sensitivity as either VRM Class III (353,371 acres) or VRM Class IV (388,942 acres), providing a lower degree of protection to these areas of high viewer sensitivity; similarly, large areas inventoried as Scenic Quality A are to be managed as VRM Class III (and 367,895 acres) and VRM Class IV (702,174 acres). Such management would allow easily seen projects and/or strongly contrasting elements to be added to these high scenic quality and/or sensitivity areas, resulting in adverse impacts to these visual values. Without other restrictions, applying VRM that is incompatible (i.e., a higher VRM Class) with an area's visual values as identified in the visual inventory, would eventually alter these areas toward a higher visual inventory class.

Table 4-12. Acres of Scenic Quality Ratings or Visual Sensitivity Levels in Visual Resource Management Classes by Alternative

VRM Class and Acreage[1]	Scenic Quality Rating				Visual Sensitivity Level			
	Special Areas[2]	A	B	C	Special Areas[2]	High	Medium	Low
Alternative A								
Class I 141,110	140,942	168	0	0	140,942	168	0	0
Class II 339,205	16	260,087	63,679	15,081	16	269,113	63,163	6,571
Class III 890,353	1	367,895	282,747	239,708	1	353,371	177,808	359,170
Class IV 1,814,373	0	702,174	672,132	444,232	0	388,942	238,335	1,191,262
Alternative B								
Class I 154,343	140,958	13,258	127	0	140,958	13,289	95	0
Class II 1,782,843	0	880,354	645,205	261,503	0	988,920	424,175	373,967
Class III 393,887	0	49,078	177,301	167,508	0	8,231	20,224	365,432
Class IV 858,162	0	392,145	200,226	270,010	0	1,409	39,149	821,823
Alternative C								
Class I 140,958	140,958	0	0	0	140,958	0	0	0
Class II 330,020	0	309,107	20,913	0	0	317,067	9,345	3,607
Class III 511,801	0	244,955	171,600	99,464	0	226,590	127,533	161,897
Class IV 2,202,239	0	776,554	826,128	599,557	0	468,192	342,548	1,391,499

Table 4-12. Acres of Scenic Quality Ratings or Visual Sensitivity Levels in Visual Resource Management Classes by Alternative (Continued)

VRM Class and Acreage[1]	Scenic Quality Rating				Visual Sensitivity Level			
	Special Areas[2]	A	B	C	Special Areas[2]	High	Medium	Low
Alternative D								
Class I 140,954	140,946	8	0	0	140,946	8	0	0
Class II 638,929	13	467,958	165,461	5,099	13	508,258	113,875	16,385
Class III 836,361	1	321,820	389,007	129,751	1	397,247	269,141	174,191
Class IV 1,573,357	3	545,024	468,385	564,163	3	106,312	100,624	1,370,636

Source: BLM 2009a
VRM Visual Resource Management
[1]Total acreage of each BLM class for each alternative. Scenic quality, sensitivity, and Visual Resource Management Class acreages shown are for BLM-administered surface.
[2] Wilderness Study Areas. For the visual resource inventory, "Special Areas" include Wilderness Study Areas and surface lands managed by other federal agencies, such as the National Park Service. However, the BLM does not assign surface lands managed by other federal agencies to a Visual Resource Management Class, and are therefore not included in this table.

Surface Disturbance

Under Alternative A, all surface-disturbing activities anticipated to occur in the Planning Area (Appendix T) may affect visual resources, although the intensity of the impact will vary by resource use and the visual values of the location. Alternative A would result in 136,415 acres of short-term surface disturbance. Adverse impact from surface-disturbing activities would be greater in areas where VRM allows disturbance that are inconsistent with the areas visual values indentified in the visual resource inventory. Small-scale, dispersed development (e.g., range improvements) will result in less contrast due to the ability to blend these developments into the natural landscape. Large-scale, concentrated development, such as oil and gas development, is likely to result in more contrast, because these developments are more difficult to blend into the surrounding landscape.

Management actions that restrict surface disturbance for the protection of other resources (e.g., soil, water, biological resources, cultural resources, and special designations) would help to protect visual values by reducing visual contrast.

Resource Uses

Under Alternative A, mineral development would result in surface disturbance that would degrade visual values, particularly in areas where VRM is inconsistent with the area's visual inventory class. Activities associated with leasable mineral and other mining, such as well pad development and road and pipeline construction, would result in adverse impacts to visual values through disturbances to the natural form, line, color, and texture in the landscape, subject to VRM restrictions. Except on the 174,354 acres of BLM mineral estate withdrawn under Alternative A, locatable mineral development would not be subject to VRM and would therefore be the most likely type of mining to result in adverse impacts to visual values.

Visual impacts from ROW projects, such as powerlines, pipelines, and wind-energy projects, are required to conform to VRM objectives, but would still result in adverse impacts to some high visual value areas

under Alternative A. In the case of renewable energy, a long-term visual contrast and, depending on location, an adverse impact to visual values would occur. Such impacts would be most likely to occur on the portion of the 2,186,620 acres managed as open to ROW authorizations where the VRM Class is less restrictive than the areas visual inventory class. Alternative A does not include specific management for renewable energy, but is instead managed consistent with other ROWs.

CTTM under Alternative A limits potential damage to resources from motorized vehicles by restricting their use to existing roads and trails in most of the Planning Area (2,332,355 acres). Allowing off-road motorized vehicle use for big game retrieval and dispersed campsite access in areas with limited travel designations may increase road and trail proliferation, introducing more contrast in the form of unnatural lines and vegetation removal. Alternative A also includes a small area (1,320 acres) managed as open to cross-country motorized travel where substantial visual contrast due from vegetation and user-pioneered routes would occur. However, because these areas have been open to cross-country motorized travel for a number of years, substantial visual contrast is already evident, resulting in visual inventory Class IV ratings.

Special Designations

Under Alternative A, management for special designations (e.g., ACECs and WSR eligible waterways) generally includes restrictions or limitations on surface-disturbing activities (such as ROW development, mining, and renewable energy) intended to protect the values for which the area is managed. Restrictions, limitations, or specific mitigation requirements for surface-disturbing activities, mining, ROW development, and renewable energy development would reduce activities that may cause visual contrast. Such restrictions may result in beneficial impacts to visual values where they limit development that results in new contrast, but is consistent with VRM objectives.

Proactive Management

Proactive management actions for visual resources under Alternative A would provide some protection for visual resources in the Planning Area by identifying or reducing the potential for adverse impacts. Alternative A requires a VRM contrast rating worksheet for all proposed actions in areas managed as VRM Class I and for all projects with a high degree of visual impact. This alternative also requires visual simulations on a case-by-case basis and limits motorized vehicle use to designated roads and trails in areas managed as VRM Classes I and II to reduce the potential for road and trail proliferation. However, because VRM classes under this alternative are not consistent with the visual inventory classes across a large portion of the Planning Area, VRM Class-specific proactive management would not benefit all areas with high visual values.

Alternative B

Alternative B emphasizes conservation of resources over resource use and would result in fewer adverse impacts compared to other alternatives by reducing development that may affect visual values, and by increasing proactive management. Under Alternative B, the BLM manages 154,343 acres of BLM-administered surface as VRM Class I, 1,782,843 acres as VRM Class II, 393,887 acres as VRM Class III, and 858,162 acres as VRM Class IV. The area managed as VRM Class IV, where major modifications to existing landscape are allowable, is smallest under this alternative. This alternative includes the largest acreage of VRM Classes I and II, (61 percent of BLM-administered surface acreage in the Planning Area) with the goal of maintaining the existing landscape character. As shown in Table 4-11, Alternative B manages the most area of any alternative consistent with or more protective than its visual values (i.e., at a lower visual inventory class). Alternative B manages the smallest acres of visual inventory Classes II and III areas as VRM Class IV (8 acres and 19,023 acres, respectively), and would generally restrict

activities where major modifications to the landscape can occur to visual inventory Class IV areas, where they would have the least adverse impact due to the lower visual value and existing disturbances in these areas.

As shown in Table 4-12, this alternative also places the majority of areas inventoried as High Sensitivity and Scenic Quality A into more protective VRM Classes I and II. More than the other alternatives, VRM under Alternative B would prevent easily seen projects and/or strongly contrasting elements from being added to these high scenic quality and/or sensitivity areas.

Surface Disturbance

Alternative B places the most restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, cultural resources, and special designations) and would result in the least surface disturbance of any alternative. These restrictions would result in the smallest potential for the creation of new visual contrast from such disturbance. For example, Alternative B applies an NSO restriction to avoid surface disturbance in big game crucial winter range year-round, compared to Alternative A, which applies a TLS for part of the year, and alternatives C and D, which do not include seasonal stipulations for the protection of big game and exempt Oil and Gas Management Areas from discretionary wildlife seasonal stipulations. In relation to the other alternatives, large-scale disturbances, high-profile intrusions, and concentrated development are the most limited under Alternative B. Because the BLM would manage the most acreage as VRM Classes I and II under Alternative B, fewer and less-intrusive activities would be permitted and the most protection to visual resources, including in high visual value visual inventory Class I and II areas, would occur. However, in locations where visual contrast from intensive development in VRM Class IV occurred, adverse impacts to visual values may still result, particularly where areas of such development abut areas of substantially higher visual value (i.e., visual inventory Class I and II) (see Map 39).

Resource Uses

Mineral resource development under Alternative B would result in the least surface disturbance of any alternative. Relatively fewer disturbances from well pad development, road, and pipeline construction would limit new visual contrast that would disrupt the natural form, line, color, and texture of the landscape.

Under Alternative B, ROW projects such as powerlines and pipelines are anticipated to result in the least disturbance and, therefore, the fewest instances of new contrast compared to the other alternatives.

Renewable energy projects are more restricted under Alternative B than the other alternatives. Alternative B classifies the most acreage as renewable energy exclusion areas and the least acreage as open to renewable energy development. Because wind-energy development is often visible from far away, even when it is placed in areas where such development is consistent with the underlying VRM Class objective, the visual values of the surrounding scenic quality rating units will be compromised and altered to a lower visual resource inventory class. Excluding and avoiding renewable energy development across large portions of the Planning Area would reduce potential adverse impacts to visual values.

CTTM under Alternative B places the most restrictions on motorized vehicle use, limiting the potential for new visual contrast from route creation. In particular, prohibiting off-road motorized vehicle use for big game retrieval in areas with limited travel designations would reduce the potential for road and trail proliferation that may adversely affect visual values. Alternative B is anticipated to result in more contrasting elements due to the creation of more new roads, hiking trails, and trailheads than Alternative A, but less than alternatives C and D.

Special Designations

Under Alternative B, impacts from management in special designations would be similar to those described for Alternative A, but would occur over a larger area. Alternative B includes the most ACECs of any alternative and manages all the WSR-eligible waterways segments discussed under Alternative A as suitable for inclusion in the NWSRS. Although most of these areas are managed under VRM Class II objectives, additional restrictions on development in the portions managed under less restrictive VRM (primarily VRM Class III) would further reduce contrast and resulting adverse impacts to visual values. Additionally, designating all LWCs as Wild Lands (571,288 acres of BLM-administered land) and managing them as VRM Class II would result in beneficial impacts to visual values in these areas.

Proactive Management

In addition to managing to meet the more restrictive VRM Class objectives under Alternative B, specific proactive management under this alternative imposes additional visual resource protections compared to the other alternatives. Alternative B requires a VRM contrast rating worksheet for all proposed actions in areas managed as VRM Class I, II, or III, and requires visual simulations and mitigation design in VRM Class I and II areas. This alternative also limits motorized vehicle use to designated roads and trails in VRM Class II areas and closes VRM Class I areas to motorized vehicle use to preserve areas of high visual resource value by reducing the potential for road and trail proliferation. Because VRM classes under this alternative are generally consistent with or more protective than the visual inventory classes for the same areas, VRM Class-specific proactive management would be more effective under this alternative than under Alternative A.

Alternative C

Management of visual resources under Alternative C places a greater emphasis on resource use and development compared to the other alternatives, and more impacts to visual values from surface-disturbing and other activities would result than under the other alternatives. Under Alternative C, the BLM would manage 140,958 acres of BLM-administered surface as VRM Class I, 330,020 acres as VRM Class II, 511,801 acres as VRM Class III, and 2,202,239 acres as VRM Class IV. Compared to the other alternatives, Alternative C manages the most area as VRM Class IV (69 percent of BLM-administered surface in the Planning Area), which may result in more visual contrast due to surface disturbance in support of resource development activities.

Alternative C manages substantial portions of the Planning Area at or above their visual inventory class (see Table 4-11) and would have the greatest adverse impacts to visual values of any alternative because it allows the construction of contrasting elements (described below and under Impacts Common to All Alternatives) incompatible with visual inventory classes. The potential for adverse impacts would be greatest where visual inventory Class II and III areas are managed as VRM Class IV (425,054 acres and 272,405 acres, respectively), but also in the 238,058 acres of visual inventory Class II managed as VRM Class III. Similar to Alternative A, this alternative would manage large areas with High Sensitivity as VRM Class III (226,590 acres) or VRM Class IV (468,192 acres) (Table 4-12). Similarly, large areas inventoried as Scenic Quality A are managed as VRM Class III (244,955 acres) or VRM Class IV (776,554 acres). Such management would allow new strongly contrasting elements to be added to these high scenic quality and sensitivity areas and, without other restrictions, would eventually alter these areas toward a higher visual inventory class.

Surface Disturbance

Alternative C would result in the most surface disturbance of any alternative and, therefore, the greatest potential for new visual contrast. Adverse impacts from surface-disturbing activities would be greater in areas where VRM allows disturbance that is inconsistent with the area's visual values indentified in the visual resource inventory. Compared to the other alternatives, Alternative C allows for more large-scale disturbances, high-profile intrusions, and concentrated developments. The larger area managed as VRM Class IV under Alternative C would allow more visually intrusive activities in the Planning Area and with less mitigation.

Alternative C places the least restriction on surface-disturbing activities for the protection of other resources, providing the least protection against new visual contrast compared to the other alternatives.

Resource Uses

Under Alternative C, mineral resource development would result in impacts similar to Alternative A, except that withdrawals under this alternative would be smaller (47,846 acres). Additionally, managing a portion of the Planning Area as Oil and Gas Management Areas (568,943 acres) would concentrate some oil- and gas-related infrastructure, which would result in additional visual contrast in these areas. However, consolidating development in these Oil and Gas Management Areas, instead of allowing for a more spread-out pattern of development, may reduce visual contrast from oil and gas development in other areas.

ROW development under Alternative C would result in impacts similar to those described under Alternative A, though to a greater degree. As a result of VRM inconsistent with the results of the visual inventory, ROW projects under Alternative C are anticipated to result in the most disturbances and, therefore, the greatest adverse impacts to some high visual value areas under this alternative. Except for Alternative A, which does not include specific management for renewable energy authorizations, Alternative C includes the most area open to renewable energy development, which would increase the potential for wind-energy development and resulting impacts to visual values.

CTTM under Alternative C places the fewest restrictions on motorized vehicle use, including managing the largest acreage as open to cross-country motorized travel, and would provide the least protection from travel-related visual contrast. Areas open to cross-country motorized travel, such as OHV "play" areas, would display substantial visual contrast due to user-pioneered routes and damage to vegetation. However, areas open to cross-country motorized travel under Alternative C are all located in visual inventory Class IV areas of the least visual value. These areas may help to concentrate this type of motorized vehicle use in these relatively small, lower visual value areas, and potentially focus use that might otherwise occur in higher visual value areas not designated for cross-country motorized travel. Allowing off-road motorized vehicle use for big game retrieval and dispersed campsite access would result in impacts similar to those under Alternative A. Alternative C is anticipated to result in the greatest surface disturbance associated with the creation of new roads and trails compared to the other alternatives and would have the greatest potential to introduce new contrasting lines to the landscape.

Special Designations

Impacts to visual resources from management of special designations would be similar to those described for Alternative A, though to a lesser degree. Under Alternative C, the BLM would designate the fewest ACECs of any alternative and would not manage eligible waterways as suitable for inclusion in the NWSRS, resulting in the least protection from adverse impacts of any alternative.

Proactive Management

Proactive management actions for visual resources under Alternative C provide the fewest protections for visual resources of any alternative. Like Alternative A, Alternative C only requires a VRM contrast rating worksheet for highly visible projects and those proposed in VRM Class I areas, but this alternative also exempts all mineral actions and activities in designated ROW corridors from this requirement. As under Alternative A, VRM inconsistent with visual inventory classes under this alternative may reduce the benefits of this management. This alternative also does not require visual simulations and does not limit motorized vehicle use by VRM class, which will not minimize the degree of contrasting elements and may not adequately mitigate the impact surface-disturbing activities to visual values.

Alternative D

Compared to the other alternatives, management of visual resources under Alternative D would balance the protection of visual values with resource uses and development. Under Alternative D, the BLM would manage 140,954 acres of BLM-administered surface as VRM Class I, 638,929 acres as VRM Class II, 836,361 as VRM Class III, and 1,573,357 as VRM Class IV. Compared to other alternatives, Alternative D manages the second smallest area as VRM Class IV.

As shown in Table 4-11, Alternative D matches VRM classes to their corresponding visual inventory class more than alternatives A and C, but less than Alternative B. For example, most visual inventory Class II areas are managed as VRM Class II, resulting in fewer adverse impacts from managing areas with higher visual values under less stringent visual objectives. Adverse impacts to the visual resource inventory would therefore be lower under this alternative than under alternatives A and C. Alternative D manages the second smallest acres of visual inventory Classes II and III areas as VRM Class IV (90,550 acres and 45,539 acres, respectively), which would restrict locations where major changes to the landscape could occur to primarily less visually valuable areas. Alternative D manages approximately 320,000 areas of visual inventory classes III and IV with more protective VRM, resulting in the potential for beneficial impacts in these areas as described under Alternative B, but to a lesser extent.

As shown in Table 4-12, this alternative also places the second largest area inventoried as High Sensitivity and Scenic Quality A into more protective VRM Classes I and II. Such VRM would increase the management protection for these areas compared to alternatives A and C, and would result in similar beneficial impacts in these areas to management under Alternative B.

Surface Disturbance

The amount of projected surface disturbance under Alternative D is more than under alternatives A and B, but less than under Alternative C. The impacts to visual values from surface disturbance would be similar to the impacts described for Alternative A, although to a lesser degree because VRM consistent with Planning Area's visual values, as indentified in the visual resource inventory, focuses disturbances likely to result in the greatest visual contrast in areas of lower visual value. As noted for Alternative A, visual contrast from surface disturbance will vary based on the type of resource use, location, and other factors. For example, compared to Alternative A, Alternative D is projected to result in more disturbance associated with the creation of new roads and trails for recreational purposes, introducing more linear features to the visual landscape, but less disturbance from mineral development.

As described under Alternative A, management actions that restrict surface disturbance for the protection of other resources, especially where they overlap areas less restrictive VRM, would further reduce visual contrast from mineral leasing, ROW development, and other activities.

Resource Uses

While mining under Alternative D would result in a similar amount of surface disturbance than Alternative A, applying VRM that is more consistent with visual inventory classes would reduce the potential for impacts to visual values, compared to that alternative. Effects from Oil and Gas Management Areas would be similar to those described for Alternative C, although to a lesser extent due to the smaller size of these areas under Alternative D (134,214 acres). Compared to alternatives A and B, Alternative D would result in fewer withdrawals (72,031 acres) and therefore may have fewer beneficial impacts to visual values.

Under Alternative D, ROW projects and renewable energy development are projected to result in the same amount of surface disturbance as under Alternative A. Nevertheless, impacts to visual resources are anticipated to be lower under Alternative D due to the compatibility of VRM with visual inventory classes and the larger acreage of ROW and renewable energy avoidance/mitigation or exclusion areas under this alternative. Compared to alternatives A and C, Alternative D would result in additional restrictions on the placement of ROWs and additional mitigation to protect visual values where ROW permits are granted. Alternative D also places more restrictions on motorized vehicle use, through closures and limiting motorized vehicle use to designated roads and trails, than alternatives A and C, but also designates the second largest area as open to cross-country motorized travel. Closing areas, limiting motorized vehicle use to designated roads and trails, and limiting off-road motorized use to access primitive campsites and to retrieve big game to within 300 feet from existing routes would reduce adverse impacts from user-pioneered routes. As with Alternative C, areas open to cross-country motorized travel under Alternative D are all located in areas of the least visual value, visual inventory Class IV areas. These areas may help to concentrate this type of motorized vehicle use in these relatively small, lower visual value areas, and potentially focus use that might otherwise occur in higher visual value areas not designated for cross-country motorized travel.

Special Designations

Under Alternative D, the BLM would manage special designations and other management areas that would minimize surface disturbance, which would reduce visual contrast beyond that required by VRM in the areas, benefitting visual values. Alternative D designates a larger portion of the Planning Area as ACECs compared to Alternative A, but less than Alternative B. Impacts from ACECs would be similar to those described under Alternative B. Alternative D does not manage any of the eligible waterways as suitable for inclusion in the NWSRS; even without special management, impacts to visual values under Alternative D would be similar as Alternative B because these waterways would be primarily managed as VRM Class I or II under both alternatives. Alternative D designates 52,485 acres of LWCs as Wild Lands, which would result in similar beneficial impacts as those described under Alternative B, but to a lesser extent.

Proactive Management

Under Alternative D, the use of VRM contrast rating worksheets and visual simulations are the same as described for Alternative A, and would allow the identification of potential adverse impacts as described under that alternative. Similar to, though to a lesser degree than, Alternative B, VRM classes under this alternative are consistent with visual inventory classes for the same areas, which may make VRM Class-specific proactive management more effective under this alternative than under alternatives A and C. Alternative D, like Alternative C, does not limit motorized vehicle use by VRM Class, which will not minimize the potential for the creation of contrasting elements from user-pioneered routes to the same degree as Alternative B.

4.6 Land Resources

4.6.1 Lands and Realty

This section describes potential impacts to the lands and realty program from implementing the alternatives. The lands and realty program includes land tenure adjustments (e.g., sales, exchanges, acquisitions), land use authorizations (i.e., leases, permits, grants), and withdrawals, classifications, and segregations. The BLM authorizes ROWs and renewable energy through lands and realty actions (land use authorizations). Refer to Sections 4.6.2 *Renewable Energy* and 4.6.3 *Rights-of-Way and Corridors* for impacts to these resource uses. This section focuses on how management actions could impact the lands and realty program by increasing, limiting, or preventing the potential for realty actions.

The purpose of the lands and realty program is to facilitate management of BLM-administered lands and resources in the Planning Area. The program adapts according to changing land management, resource needs, demand for public land to meet expanding communities and other public purposes, and other issues. Therefore, lands and realty program actions generally result in beneficial impacts to multiple-use objectives in the Planning Area.

Adverse impacts to the lands and realty program result from management actions that reduce the available land base or make land tenure adjustments or land use authorizations more difficult to complete. Beneficial impacts to lands and realty result from land tenure adjustments that increase land management efficiency or enhance the management of resources through consolidation of public lands into more easily managed blocks. Direct impacts to lands and realty occur when other resources are present, preventing or making it more difficult to complete a transaction. Mitigating resource values required for a land disposal transaction can require additional lands and realty actions and increase processing costs and timeframes required to complete the transaction, which would temporarily delay the transaction. Indirect impacts to the lands and realty program result from management that subsequently affects realty actions, such as the development of parcels disposed out of BLM ownership, which can increase, limit, or prevent the potential for future realty actions. Most impacts to the lands and realty program are long-term and result from management that allocates land for land tenure adjustments or land use authorizations over the life of the plan.

4.6.1.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- The demand for land tenure adjustments and land use authorizations will increase over the life of the plan.
- The BLM's ability to respond to or to satisfy increased demands for land tenure adjustments will be limited by budget and personnel constraints into the foreseeable future.
- Land acquisition is a support function for resources programs (e.g., cultural resources, fish and wildlife, recreation). The priority or the urgency associated with any acquisition is established by the resource program benefiting from the acquisition.
- Public lands are managed under BLM guidance and policy. The lands and realty program follows guidance when disposing of public lands or when acquiring lands to support BLM management programs.
- The number of land use authorizations will increase over the life of the plan.
- Disposal of lands would be consistent with disposal criteria.

- All proposed land tenure adjustments would require site-specific NEPA review and determination of mineral development potential in accordance with FLPMA sections 206 and 209.
- Before any potential land disposal, mineral development potential would be evaluated according to FLPMA sections 206 and 209.
- The BLM will retain existing withdrawals not otherwise specified in the alternatives.
- The BLM would use voluntary approaches to increase access to lands.
- Except where specified, BLM-administered lands will be retained in federal ownership.
- During the life of this RMP, the BLM will continue to address known trespass issues; however, additional trespasses may continue during the life of the plan. Continued resolution of trespass issues will depend on staff and funding availability.
- Consolidation of public lands would decrease the cost of public land administration in the Planning Area and enhance efficiency in management of the remaining public lands.
- Within acquisition zones, priority would be given to identified special designations.
- No net change in AUMs would result from implementing land disposal and land acquisition actions, other than those actions with an agricultural entity (e.g., Westside irrigation project).

4.6.1.2 Summary of Impacts by Alternative

Impacts to the lands and realty program from implementing the alternatives include land disposal, acquisition, and withdrawal, and management that makes realty actions more difficult to complete. Alternative B includes the most area for standard acquisition (228,164 acres), followed by Alternative D (228,148 acres), and Alternative C (87,068). Alternative C includes the largest area available for disposal (117,961 acres), followed by Alternative A (116,800 acres), Alternative D (66,022 acres), and Alternative B (24,267 acres). In the past, there has been an overall net decrease of BLM-administered land in the Planning Area and this trend is expected to continue under all the alternatives. Long-term impacts associated with the withdrawal and segregation of lands would be the greatest under Alternative B, because the BLM would withdraw the largest area, followed by alternatives A, D, and C, respectively.

Land will continue to be available for community expansion under all alternatives, with Alternative C providing more opportunities for small-scale property boundary adjustments and agricultural expansion for private land owners. Long-term impacts associated with the withdrawal and segregation of lands would be the greatest under Alternative B, because the BLM would withdraw the largest amount of acreage, followed by Alternative A, and alternatives D and C.

4.6.1.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

This section describes impacts to the lands and realty program from management common to all alternatives.

Land Tenure Adjustments

Under all alternatives, acquiring state and private lands from willing sellers to consolidate the land ownership pattern would result in long-term beneficial impacts to the lands and realty program by increasing the land base and enhancing the BLM's ability to effectively manage resources and resource uses (e.g., wildlife habitats, riparian/wetland areas, special designations). Consolidating public lands

also results in long-term beneficial impacts by improving access to public lands, reducing the number of easements needed, and helping reduce conflicts from encroachment and subdivision of private land by adjacent property owners.

Pursuing access easements across private lands for access to BLM-administered land under all alternatives would result in long-term benefits to the lands and realty program by eliminating the need for future land acquisitions to meet resource use needs and reducing potential trespass conflicts with other landowners. Identifying areas of interest for acquiring easements (Appendix M) also would benefit the lands and realty program.

Conveyance of 16,122 acres of land to the Westside Irrigation District would create long-term impacts to the lands and realty program by removing these lands from the land base available for land tenure adjustments and land use authorizations.

Special designations (WSAs, ACECs, WSRs) and the designation of SRMAs could encourage the acquisition of adjacent private and state lands and inholdings, and affect the lands and realty program for as long as these areas are designated. Acquiring adjacent lands or inholdings in or surrounding designated areas would improve the manageability of these areas.

Similar to land use authorizations, requiring on-the-ground surveys (for paleontological, cultural, and other resources) before any land disposal action could create long-term adverse impacts to the lands and realty program. Requiring resource inventories, surveys, and analyses before land tenure adjustments and land use authorizations could make it more difficult to complete lands and realty actions. Site-specific NEPA analyses for land tenure adjustments and land use authorizations could further decrease the efficiency of processing land tenure adjustments and land use authorizations.

Ensuring that important Native American TCPs and historic properties are not transferred from BLM ownership or affected by management in ways that restrict or deny access could affect the lands and realty program over the long term. Preventing land tenure adjustments or land use authorizations that may affect these sites reduces the land base available for lands and realty actions.

Pursuing acquisition of small parcels of land from private landowners for cultural and other resource values (such as acquiring the private land portions of the Legend Rock Petroglyph Site) would result in long-term beneficial impacts to the lands and realty program. However, because of the small size of these acquisitions, benefits would be minimal.

Land Use Authorizations

Under all alternatives, the BLM considers land use authorizations (permits, grants, etc.) on a case-by-case basis consistent with other resource objectives. During processing of a land use authorization, the BLM would perform site-specific inventories and NEPA analyses for cultural, paleontological, biological, and other appropriate resources as part of the case-by-case assessment. Identifying these resources in areas considered for a land use authorization may require mitigation, implementation of BMPs, and other stipulations, or the BLM may deny the application. If the BLM denies the application, there may be indirect impacts to lands and realty from an applicant pursuing land use authorizations in other areas.

Responding to R&PP applications and approving leases and conveyances to qualified applicants would benefit the lands and realty program by providing locations for certain uses (e.g., shooting ranges, landfills) that may reduce illegal use, trespass, or other issues on other BLM-administered land.

Retaining classification of BLM-administered land for the future expansion of Park County landfill south of Cody and of lands to the north, south, and west of the Worland landfill would have long-term impacts

to the lands and realty program by classifying these areas in preparation of an R&PP lease or conveyance. These lands would not be available for other land tenure adjustments and land use authorizations.

Impacts specific to ROW and renewable energy development are discussed in their respective sections of this chapter.

Withdrawals, Classifications, and Segregations

Table 4-13 summarizes withdrawals and segregations by alternative. Withdrawals that close areas to operation of the public land laws cause long-term impacts to the lands and realty program by limiting or restricting lands and realty actions in these areas. Reviewing other agency withdrawals and BLM-administered power withdrawals would help the BLM determine whether the withdrawals are serving or are needed for their intended purposes. Revoked or modified withdrawals could open these public lands to allocation and management under the public land laws and mining laws. Opening public lands to management and allocation would result in long-term impacts to the lands and realty program by increasing the available land base for land tenure adjustments and land use authorizations.

Table 4-13. Withdrawals, Classifications, and Other Segregations in the Planning Area

Field Office	Name	Acres by Alternative				Segregates/Withdraws from	
		Alternative A	Alternative B	Alternative C	Alternative D	Disposal	Locatables
Resource Protection							
CYFO	Stock Driveway	33,781	33,781	33,781	33,781	■	
WFO	Stock Driveway	59,063	59,063	59,063	59,063	■	
CYFO	Cave and Karst Areas	0	270	270	270		■
WFO	Cave and Karst Areas[1]	8,560	8,560	8,560	8,560		■
CYFO	Spirit (Cedar) Mountain Cave	234	234	234	234	■	■
CYFO	Horsethief/ Natural Trap Caves	519	566	566	381	■	■
WFO	Big Cedar Ridge Paleontological Area	264	264	0	264	■	■
WFO	Red Gulch Dinosaur Tracksite	1,798	1,798	0	1,798	■	■
WFO	Castle Gardens Recreation Site	110	110	110	110	■	■
CYFO	Beck Lake Scenic Area (Proposed)	708	708	0	708	■	■
CYFO	National Historic Landmark	72	72	72	72		■

Table 4-13. Withdrawals, Classifications, and Other Segregations in the Planning Area (Continued)

Field Office	Name	Acres by Alternative				Segregates/Withdraws from	
		Alternative A	Alternative B	Alternative C	Alternative D	Disposal	Locatables
Management Areas							
CYFO	ACECs	11,947	252,133	0	16,689		■
WFO	ACECs[1]	20,538	21,798	8,560	8,689		■
CYFO	WSRs	4,863	6,752	0	0		■
WFO	WSRs	12,208	15,401	0	0		■
Other Segregations							
CYFO	Cody Industrial Park	0	208	0	209		■
CYFO	Restored U.S. BOR lands not open to entry[2]	0	0	0	0	■	■
WFO	Restored U.S. BOR lands not open to entry[2]	0	0	0	0	■	■
WFO	BLM-WSO Public Water Reserve	2,138 Existing	2,138	0	2,138	■	■
CYFO	BLM-WSO Public Water Reserve	625	625	0	625	■	■
WFO	BLM-WSO Power Site Reservation	159	159	159	159	■	■
CYFO	BLM Power Site Reservation	3,309	3,786	3,309	2,094	■	■
Other Federal Agency Withdrawals							
WFO	Power Site Classification (FERC)	1,197	1,197	1,197	1,197	■	■
CYFO	Power Site Classification (FERC) (Clarks Fork of the Yellowstone and Bighorn rivers)	15,698	15,698	15,698	14,841	■	■
CYFO	Department of Defense (Lovell Military Training Area)	3,543	3,543	3,543	3,543	■	■
CYFO	National Park Service - Big Horn Recreation Area	15,634	15,635	15,635	15,635	■	■

Table 4-13. Withdrawals, Classifications, and Other Segregations in the Planning Area (Continued)

Field Office	Name	Acres by Alternative				Segregates/Withdraws from	
		Alternative A	Alternative B	Alternative C	Alternative D	Disposal	Locatables
WFO	U.S. BOR (Irrigation Projects)	1,419	0	0	0	■	■
CYFO	U.S. BOR (Irrigation Projects)	83,521	0	0	0	■	■
CYFO	U.S. Forest Service – Wood River Guard Station	40	40	40	40	■	■

Source: BLM 2009a
Note: Due to overlapping resources, numbers are not additive.
[1] Withdrawals for cave and karst areas that overlap the Spanish Point Karst ACEC are counted in both locations.
[2] Lands restored to the BLM by the BOR are closed to locatable mineral entry and disposal, not withdrawn. These lands are included under "segregations" because the closure has a segregating effect.

ACEC Area of Critical Environmental Concern
BLM Bureau of Land Management
BOR Bureau of Reclamation
CYFO Cody Field Office
FERC Federal Energy Regulatory Commission
U.S. United States
WFO Worland Field Office
WSO Wyoming State Office
WSRs Wild and Scenic Rivers

Alternative A

Land Tenure Adjustments

Alternative A identifies a total of 116,800 acres in the Planning Area for disposal by sale, exchange, or other means (Map 42) for community expansion, exchanges, and other purposes, subject to the disposal criteria (Appendix M). Alternative A identifies the remaining land base of 3,073,014 acres of BLM-administered surface ownership for retention (Map 42). Disposal of lands out of federal ownership could result in indirect impacts if the new landowner develops the land. Development of disposed land could increase management difficulties and diminish resource values on adjacent BLM-administered lands (due to visual impacts, noise, barriers to migration, etc.). Reducing the resource values of BLM-administered land could increase the potential for disposal of additional BLM-administered land and result in long-term impacts to the lands and realty program. Lands identified for retention identify the BLM-administered land base to be kept in federal ownership; however, these lands could still be disposed of on a case-by-case basis. Lands kept in retention result in long-term impacts to the lands and realty program because land tenure adjustments and land use authorizations could occur on these lands, consistent with other resource objectives.

Under Alternative A, the BLM would pursue the acquisition of private or state land to enhance resource objectives, consolidate management, and enhance public access in:

- Important wildlife areas
- Public lands on the Bighorn, Shoshone, Clarks Fork of the Yellowstone, and Greybull rivers; Gooseberry Creek; the upper portions of Cottonwood and Grass creeks; and on lands where other riparian areas occur to enhance recreational opportunities and wildlife management
- Lands with significant paleontological resources (case by case)

- Areas in the Bighorn River SRMA for hunting, fishing, boating, and camping
- The Tatman Mountain Area for recreational opportunities
- Areas in Horse Mountain, Trapper Creek, and White Creek for hunting, fishing, and camping
- The Brokenback Logging Area, including North and South Brokenback creeks for hunting, fishing, boating, and camping
- Areas in the South Bighorns including Otter Creek, Deep Creek, Little Canyon Creek, and along the Nowood River
- The Canyon Creek area for hunting, fishing, and camping
- Area in the Carter Mountain ACEC
- Bobcat Draw WSA

Acquiring these areas would result in long-term beneficial impacts to the lands and realty program by enhancing management efficiency and consolidating land ownership in these areas.

Under Alternative A, considering DLE applications for unclassified lands on a case-by-case basis, subject DLE criteria, would cause long-term impacts to the lands and realty program by removing these lands from the land base for potential land use authorizations and land tenure adjustments. However, because most of the lands suitable for agricultural development in the Planning Area have already been transferred into private ownership, impacts would be minimal.

Land Use Authorizations

Under Alternative A, the BLM considers land use authorizations on a case-by-case basis consistent with other resource objectives. Impacts to lands and realty from land use authorizations result primarily from management actions associated with ROWs, communications sites, and renewable energy, which are discussed in their respective sections.

Withdrawals, Classifications, and Segregations

Under Alternative A, the BLM pursues withdrawals on a total of 174,354 acres (Map 9). Table 4-13 summarizes withdrawals by area and type. Withdrawals that close areas to operation of the public land laws cause long-term impacts to the lands and realty program by limiting or restricting lands and realty actions in these areas.

Alternative B

Land Tenure Adjustments

Alternative B identifies areas for land tenure adjustments by type of zone for acquisition, retention, and disposal (Map 43), subject to the criteria for each zone (Appendix M). Table 4-14 lists acreages associated with each type of zone under alternatives B, C, and D.

The impacts of disposal and retention would be similar to those for Alternative A, except that Alternative B identifies more area for disposal (including disposal with restrictions and disposal for specific uses). However, disposals in areas available for special disposal (Zones 1B and 1C; most of the area available for disposal under Alternative B) would occur only rarely and only under special circumstances. The total acreage in Zones 2, 2A, 2B, and W under Alternative B is 24,267 acres, which is less than the area available for standard disposal under Alternative A. Designating zones for land tenure adjustments would result in long-term benefits to the lands and realty program by identifying preferred locations for these actions. Designating these areas would increase the efficiency of processing land tenure adjustments and would provide the public with defined areas and criteria for disposal,

acquisition, and retention of BLM-administered lands, which could increase the potential for realty actions.

Table 4-14. Land Tenure Adjustment Zones by Alternative

Zone	Acreage		
	Alternative B	Alternative C	Alternative D
Zone 1 – Retention	4,375	146,231	5,151
Zone 1A – Retention, Acquisition	228,164	87,068	228,148
Zone 1B – Retention, Acquisition, Special Disposal[1]	2,773,260	793,529	800,798
Zone 1C – Retention, Special Disposal[1]	161,182	2,045,022	2,089,781
Zone 2 – Disposal	3,844	88,452	41,315
Zone 2A – Disposal for Community Expansion	3,951	8,986	5,033
Zone 2B – Disposal for Agricultural Expansion/Property Boundary Adjustment	350	4,036	3,240
Zone W – Disposal for the Westside Irrigation Project	16,122	16,122	16,122

Source: BLM 2009a
[1] Disposals in these zones would occur only in special situations, so the acreage from this zone actually disposed of would likely be a small percentage of the total acreage listed.

Under Alternative B, the BLM would pursue acquisition of all areas identified under Alternative A. In addition, under Alternative B the BLM would pursue the acquisition of the following:

- Private lands with vertebrate or other scientifically significant paleontological resources and values adjacent to public lands for protection via exchange, purchase, or donation from a willing seller
- Lands and interests in lands for public access for motorized and/or mechanized access in the Trapper Creek RMZ
- Lands and interests in lands in the Brokenback/Logging Road RMZ including Luman Creek Road, Military Creek Road, Dorn Draw Road, and other sites determined on a case-by-case basis
- Lands and interests in lands in the South Bighorns RMZ including Cherry Creek Road to Hazelton Road Back Country Byway and Lysite Mountain, access to lands within Spring Creek, Spring Creek Road to Rome Hill Road, and other sites determined on a case-by-case basis
- Inholdings and lands or interests in lands within all WSA boundaries

Impacts from pursuing acquisitions would be similar to Alternative A, although to a slightly greater extent because Alternative B identifies more areas for acquisition.

Under Alternative B, the BLM would terminate existing DLE classifications and would not classify new lands for this purpose. This would result in long-term impacts to the lands and realty program by opening these lands to allocation under the public land laws. Because these areas are small (1,409 acres), impacts from opening these lands would be minimal.

Under Alternative B, disposing of the federal mineral estate under the Cody Industrial Park to entities who wish to purchase the surface estate would result in long-term impacts to lands and realty. Disposing of the mineral (sub-surface) estate along with the surface area would eliminate potential issues associated with split-estate management. However, disposing of federal mineral estate would reduce the total available land base of federal minerals in the Planning Area.

Under Alternative B, pursuing conservation easements on lands adjacent to areas managed as VRM Class I and II would result in long-term benefits to the lands and realty program by increasing the land base available for realty actions and increasing management effectiveness in these areas.

Land Use Authorizations

Under Alternative B, the BLM would consider land use authorizations on a case-by-case basis consistent with other resource objectives. Impacts to lands and realty from land use authorizations result primarily from management actions associated with ROWs, communications sites, and renewable energy, which are discussed in their respective sections.

Withdrawals, Classifications, and Segregations

Under Alternative B, the BLM would pursue withdrawals on a total of 325,102 acres in the Planning Area (Map 10). Table 4-13 summarizes withdrawals by area and type of segregation. Alternative B identifies more areas for withdrawal than Alternative A, including ACECs (273,931 acres), WSR suitable waterway segments (26,742 acres), and the Cody Industrial Park (208 acres). Withdrawals that close areas to operation of the public land laws would result in impacts similar to Alternative A, although to a greater extent because Alternative B would withdraw more acreage. Alternative B includes more area pursued for withdrawal than any of the other alternatives.

Alternative C

Land Tenure Adjustments

Similar to alternatives B and D, Alternative C identifies areas for land tenure adjustments by type of zone for acquisition, retention, and disposal (Map 44), subject to the criteria for each zone (Appendix M). Table 4-14 lists acreages associated with each type of zone under the alternatives. Impacts from disposal and retention of lands would be similar to those for Alternative A, since Alternative C places roughly the same acreage in Zones 2, 2A, 2B, and W (117,961 acres) as are available for standard disposal under that alternative. However, Alternative C identifies more area for disposal (including disposal with restrictions and disposal for specific uses) and less area for retention than alternatives A, B, and D. The larger acreages of BLM-administered lands identified for disposal under Alternative C may benefit private landowners and community development more than the other alternatives. Designating land tenure adjustment zones would result in impacts similar as for Alternative B.

Under Alternative C, the emphasis for acquisition of lands and interests in lands in recreation areas and special designations is to address use and user conflicts, public health and safety, or resource protection. Long-term impacts to the lands and realty program could result from not identifying lands that could increase management efficiency and help meet management objectives in these areas. Future acquisitions of lands or interests in lands to accomplish these goals may be more difficult.

Under Alternative C, considering DLE applications for unclassified lands on a case-by-case basis would result in the same impacts as for Alternative A.

Under Alternative C, maintaining the mineral estate under the Cody Industrial Park would result in long-term adverse impacts to lands and realty by creating a split-surface estate where the BLM administers sub-surface minerals and a private landowner manages the surface area. However, maintaining the federal mineral estate would retain the minerals in federal ownership and contribute to the overall federal mineral land base in the Planning Area.

Land Use Authorizations

Under Alternative C, the BLM would consider land use authorizations on a case-by-case basis consistent with other resource objectives. Impacts to lands and realty from land use authorizations result primarily from management actions associated with ROWs, communications sites, and renewable energy, which are discussed in their respective sections in this chapter.

Withdrawals, Classifications, and Segregations

Under Alternative C, the BLM would pursue withdrawals on a total of 47,846 acres of federal mineral estate in the Planning Area (Map 11). Table 4-13 summarizes withdrawals by area and type. Withdrawals that close areas to operation of the public land laws would result in impacts similar to Alternative A, although to a lesser extent because the BLM would withdraw fewer acres under Alternative C. Under Alternative C, the BLM would pursue the least area for withdrawals compared to the other alternatives.

Alternative D

Land Tenure Adjustments

Similar to alternatives B and C, Alternative D identifies areas for land tenure adjustments by type of zone for acquisition, retention, and disposal (Map 45), subject to the criteria for each zone (Appendix M). Table 4-14 lists acreages associated with each type of zone. Impacts from disposal and retention of lands would be similar to Alternative A. Alternative D has more area identified for disposal (with 66,022 acres in Zones 2, 2A, 2B, and W) than Alternative B, but less than alternatives A and C (including disposal with restrictions and disposal for specific use). Alternative D identifies more area for retention than alternatives A and C, but less than Alternative B. Under Alternative D, management and acquisition of lands along the Bighorn River would be similar to Alternative C, with the addition of other river tracts acquired over the life of the plan. Under Alternative D, areas considered for acquisition in the Bighorn River SRMA would be the same as for Alternative A, with similar long-term beneficial impacts. Similar to Alternative B, Alternative D emphasizes the acquisition of lands for legal and physical access in recreational areas to maximize recreational opportunities. Acquiring lands in recreational areas would result in long-term benefits in these areas by increasing management efficiency, consolidating ownership, and reducing the potential for trespass and illegal access. Under Alternative D, considering DLE applications for unclassified lands on a case-by-case basis would result in the same impacts as Alternative A. Similar to Alternative B, disposing of the federal mineral estate under the Cody Industrial Park to entities who wish to purchase the surface estate would result in long-term impacts to lands and realty. However, disposing of the mineral (sub-surface) estate along with the surface area would eliminate potential issues associated with split-estate management described for Alternative C. Pursuing conservation easements on lands adjacent to areas managed as VRM Class I and II would result in long-term benefits, but pursuing these easements on a case-by-case basis may decrease the potential (and quantity) of easements compared to Alternative B.

Land Use Authorizations

Similar to the other alternatives, under Alternative D, the BLM considers land use authorizations on a case-by-case basis, consistent with other resource objectives. Impacts to lands and realty from land use authorizations result primarily from management actions associated with ROWs, communications sites, and renewable energy, which are discussed in their respective sections in this chapter.

Withdrawals, Classifications, and Segregations

Under Alternative D, the BLM would pursue withdrawals on a total of 72,031 acres in the Planning Area (Map 12). Table 4-13 summarizes withdrawals by area and type of segregation. Withdrawals that close areas to operation of the public land laws would have similar impacts to Alternative A, although to a lesser extent because the BLM would withdraw fewer acres under Alternative D. Under Alternative D, the BLM would pursue withdrawals for more acres than Alternative C but fewer than alternatives A and B.

4.6.2 Renewable Energy

This section describes potential impacts to renewable energy development from implementing the alternatives. The BLM approves renewable energy facilities for wind, solar, and biomass through ROW authorizations. Therefore, the descriptions of impacts to ROWs and corridors in this chapter (including restrictions and avoidance/mitigation and exclusion areas) apply to renewable energy development. This section focuses on management specific to renewable energy development in the alternatives that would increase, limit, or prohibit renewable energy development (in addition to that discussed in Section 4.6.3 *Rights-of-Way and Corridors*). Wind energy is the only type of anticipated renewable energy development in the Planning Area. Therefore, this section primarily describes impacts to wind-energy development. Map 46 shows wind-energy development potential in the Planning Area based on wind power class ratings. Impacts to geothermal resources are discussed in Section 4.2.4 *Leasable Minerals - Geothermal*.

Adverse impacts to renewable energy include management that limits or prohibits the development of renewable energy resources. Beneficial impacts to renewable energy result from management actions and resource uses that increase the potential for renewable energy development. Conversely, adverse impacts to renewable energy development result from actions or uses that decrease such development potential.

Direct impacts to renewable energy include management actions that designate renewable or ROW energy avoidance/mitigation and exclusion areas. Other examples of direct impacts include resource uses that conflict with or prohibit the development of renewable energy, such as development of a surface mine in an area with a high wind-power-class rating. Indirect impacts to renewable energy include management actions that result in subsequent restrictions, such as management for resource values that require mitigation, relocation, or denial of authorizations for renewable energy. Impacts to renewable energy would be long-term.

4.6.2.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Wind energy is the most likely type of renewable energy to be developed in the Planning Area; however, due to emerging research and technology, other types of renewable energy development may increase during the life of the plan.
- With advances in technology, lands with moderate (Class 2 to 3) potential may become more attractive for renewable energy development.
- Wind-energy demand and development is expected to increase during the life of the plan related directly to energy prices, national and state policy involving renewable energy, and other factors that encourage demand for and development of renewable energy resources.

- Wind-energy development will be in accordance with the BLM Final Programmatic EIS on Wind Energy Development on BLM-Administered Lands in the Western United States, IM 2009-043 (Wind Energy Development Policy) and any future BLM policy or guidance for wind-energy development.
- Increased development of wind-energy turbines (or other renewable energy) also would increase the demand for ROW authorizations for transmission lines to distribute produced energy to the grid.
- The potential for wind-energy development in the Planning Area will be in direct relation to wind power classification ratings (Map 46), proximity to transmission lines, and impacts to other resources or resource uses (such as visual resources).
- For analysis purposes, the percentage of electrical energy generated from wind would increase from 0.8 percent of total generation in 2007 to 2.5 percent by 2030 (EIA 2009).
- Because the BLM authorizes facilities and infrastructure associated with wind, solar, and biomass development through ROW grants, the location and development of renewable energy facilities relates directly to the ability of the lands and realty staff to process ROW authorizations.
- Management objectives for other resources and resource uses may limit the location and development of wind-energy infrastructure in the Planning area.
- Mapping of renewable energy potential (wind power classifications) is based on a large-scale nationwide mapping (BLM 2005a). Site-specific monitoring and testing may indicate areas with higher (or lower) wind-energy potential than previously identified.
- Wind-energy development would likely occur in areas open to wind-energy development more than in areas avoided to wind-energy development.
- Any wind-energy development would require site-specific NEPA review.

4.6.2.2 Summary of Impacts by Alternative

Impacts to renewable energy development would result from restrictions that limit or prohibit renewable energy development, including the designation of renewable energy avoidance/mitigation and exclusion areas. Each alternative proposes restrictions on renewable energy development to a varying degree of intensity.

Under Alternative A, no specific renewable energy avoidance/mitigation or exclusion areas are identified. Alternative B includes the most restrictions and constraints to renewable energy development, with 1,251,869 acres managed as exclusion areas and 1,691,497 acres managed as avoidance/mitigation areas. Alternative B also includes the most constraints to renewable energy development in ACEC areas, followed by alternatives D and C. Alternative D is the second most constraining alternative, with 294,345 acres managed as renewable energy exclusion areas and 2,501,876 acres managed as avoidance/mitigation areas. Alternative C is less constraining to renewable energy development than alternatives B and D, with 151,506 acres managed as renewable energy exclusion areas and 1,612,547 acres managed as avoidance/mitigation areas. Management under all alternatives would seek to minimize impacts to other resources from renewable energy development, which may result in adverse impacts through siting and design requirements and mitigation that could limit development.

4.6.2.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Under all alternatives, the development of renewable energy would consider the management and objectives of other resources. Considering the management of other resource objectives could restrict the development of renewable energy in certain areas or impose siting and design requirements or other mitigation that could limit the potential for development.

Government-to-government consultation with potentially affected Tribes could further limit or restrict the development of renewable energy in the Planning Area. However, consultation with Tribes could also increase the potential for successful renewable energy development by establishing communication with Tribes to allow for more effective and collaborative planning of projects.

Under all alternatives, WSAs are closed to renewable energy development, which would result in long-term adverse impacts by prohibiting the development of renewable energy in these areas.

Alternative A

Under Alternative A, no specific renewable energy avoidance/mitigation or exclusion areas are identified. Renewable energy projects are considered on a case-by-case basis. However, exclusion and avoidance/mitigation areas for ROWs would apply to the development of wind-energy (and solar and biomass) facilities. Wind-energy development also is constrained by existing management policies and prohibitions involving lands with high resource values. Case-by-case permitting of renewable energy projects increases the processing timeframe and costs associated with these facilities. Case-by-case permitting of renewable energy could also result in a distributed pattern of renewable energy development and require additional ROW authorizations to support required infrastructure such as transmission lines to distribute the energy.

Management actions for ROW authorizations would have long-term impacts to renewable energy development. Management actions that restrict ROW authorizations in areas of high potential for wind energy (Map 46) would limit the potential for development in these areas. Additionally, management for ROWs that limits or restricts the development of ROWs (including transmission lines) in areas needed to connect renewable energy facilities to the electrical grid would also adversely impact renewable energy development.

Under Alternative A, all management for ROW exclusion and avoidance/mitigation applies to renewable energy, except that renewable energy is open in the following areas, all of which are ROW avoidance/mitigation areas:

- Brokenback/Logging Road RMZ
- South Bighorns area
- Canyon Creek area
- Basin Gardens Play Area
- Basin Gardens

Alternative A manages only the fossil concentration area in the Big Cedar Ridge ACEC and the Heart Mountain Relocation Center National Historic Landmark as ROW exclusion areas.

Requiring a visual contrast rating worksheet in VRM Class I areas for projects would affect renewable energy development in these areas; wind turbines cause a high degree of visual impact because of their size. A visual contrast rating worksheet may reveal visual impacts of renewable development and result

in mitigation to meet VRM objectives in VRM Class I areas, or the BLM may prohibit development if visual impacts cannot be adequately mitigated.

Alternative B

Under Alternative B, a total of 246,448 acres is open to renewable energy development (area not included in renewable energy avoidance/mitigation or exclusion areas). Identifying areas open to renewable energy development would reduce the potential for adverse impacts associated with case-by-case permitting described under Alternative A. Implementation of Alternative B would result in an approximate 92 percent decrease in area open for renewable energy development compared to Alternative A.

Under Alternative B, a total of 1,691,497 acres are managed as renewable energy avoidance/mitigation areas. Managing renewable energy avoidance/mitigation areas would create long-term adverse impacts by limiting the development of renewable energy in these areas and potentially placing additional constraints, mitigation, monitoring, or other stipulations on development approved in avoidance/mitigation areas. Under Alternative B, the Chapman Bench, Foster Gulch Paleontological Area, McCullough Peaks South Paleontological Area, Rainbow Canyon, and Sheep Mountain ACECs are managed as renewable energy avoidance/mitigation areas.

Under Alternative B, a total of 1,251,869 acres are managed as renewable energy exclusion areas. Allocation of renewable energy exclusion areas would result in long-term adverse impacts by prohibiting the development of renewable energy in these areas. Under Alternative B, the Clarks Fork Basin/Polecat Bench, Clarks Fork Canyon, and Rattlesnake Mountain ACECs are managed as renewable energy exclusion areas.

Under Alternative B, all management for ROW exclusion and avoidance/mitigation applies to renewable energy except that renewable energy is excluded in the Brokenback/Logging Road RMZ, which is a ROW avoidance/mitigation area.

Designation of ACECs under Alternative B would create adverse impacts to renewable energy as these areas are all managed as renewable energy avoidance/mitigation or exclusion areas. Renewable energy development would be limited or prohibited in these areas.

Avoiding wind-energy development in big game winter ranges and parturition habitat, raptor concentration areas, and mitigating wind-energy development for the protection of greater sage-grouse nesting, brood-rearing, and winter concentration areas would result in long-term adverse impacts to renewable energy by limiting development in these areas.

Managing areas within 5 miles of trails and eligible NRHP and TCP sites as exclusion areas for wind-energy development (unless screened from the site by intervening topography) would result in long-term adverse impacts to renewable energy by prohibiting facilities in these areas.

Requiring a visual contrast rating worksheet in VRM Class I, II, or III areas and requiring a visual simulation and design mitigation for all areas viewable from VRM Class I and II areas would create adverse impacts to renewable energy development. Wind turbines are large structures and these VRM requirements prior to project approval may limit wind-energy development in these areas or necessitate certain design requirements that make projects infeasible.

Alternative C

Under Alternative C, a total of 1,425,762 acres are open to renewable energy development (area not included in renewable energy avoidance/mitigation or exclusion areas). Identifying areas open to

renewable energy development would reduce the potential for adverse impacts associated with case-by-case permitting described under Alternative A. Implementation of Alternative C would result in an approximate 479 percent increase in area open for renewable energy development compared to Alternative B.

Under Alternative C, a total of 1,612,547 acres are managed as renewable energy avoidance/mitigation areas. Long-term impacts would be similar to those described for Alternative B, although to a lesser extent because Alternative C allocates less acreage.

Under Alternative C, a total of 151,506 acres are managed as renewable energy exclusion areas. Impacts would be the same as for Alternative B, although to a lesser extent because Alternative C allocates less acreage.

Managing areas within 5 miles of trails and eligible NRHP and TCP sites as avoidance/mitigation areas for wind-energy development (unless screened from the site by intervening topography) would create adverse long-term impacts to renewable energy by limiting facilities in these areas. If renewable energy is allowed in these areas, it may require substantial siting and design requirements and other BMPs to ensure the protection of cultural resources.

Requiring a visual contrast rating worksheet in VRM Class I areas would result in the same impacts to renewable energy development as those described under Alternative A, although to a lesser extent because of exemptions in allocated ROW corridors.

Alternative D

Under Alternative D, a total of 393,593 acres are open to renewable energy development (area not included in renewable energy avoidance/mitigation or exclusion areas). Identifying areas open to renewable energy development would reduce the potential for adverse impacts associated with case-by-case permitting described under Alternative A. Alternative D would result in approximately 60 percent more area open for renewable energy development than Alternative B and approximately 72 percent less than Alternative C.

Alternative D manages a total of 2,501,876 acres as renewable energy avoidance/mitigation areas, the most of any alternative. Long-term impacts would be similar to Alternative B, although to a greater extent because Alternative D allocates more acreage as avoidance/mitigation areas. Similar to Alternative B, Alternative D designates the Chapman Bench area and the Sheep Mountain ACEC as a renewable energy avoidance/mitigation area.

Alternative D manages a total of 294,345 acres as renewable energy exclusion areas. Impacts would be the same for Alternative B, although to a lesser extent because Alternative D allocates less acreage as exclusion areas.

Collocating renewable energy ROWs where possible in the Southern Bighorns ERMA may result in long-term impacts to renewable energy development by limiting the location of renewable energy facilities and related infrastructure (e.g., roads and transmission lines) in this area.

Avoiding wind-energy projects in big game winter range and parturition habitat, raptor concentration areas, and greater sage-grouse Key Habitat Areas would result in long-term impacts to renewable energy similar to Alternative B. Avoidance in these areas would constrain the development of wind resources.

Avoiding surface-disturbing activities (including renewable energy development) up to 3 miles from important cultural sites and requiring the use of BMPs to avoid or mitigate adverse impacts would result

in lesser long-term adverse impacts to renewable energy than those described under alternatives B and C. If renewable energy development is allowed in these areas, authorization may require substantial siting and design requirements and other BMPs to protect important cultural sites.

Requiring a visual contrast rating worksheet in VRM Class I areas would result in the same impacts to renewable energy development as those described under Alternative A.

4.6.3 Rights-of-Way and Corridors

This section describes the potential impacts to ROWs and corridors from implementation of the alternatives. ROWs are for infrastructure and facilities that are in the public interest and require authorization for location over, under, on, or through BLM-administered land. A ROW grant is a land use authorization for a specific area of public land for certain types of projects, such as developing roads, pipelines, transmission lines, and communication sites. Renewable energy facilities (wind, solar, biomass) are also authorized through a ROW, and impacts discussed in this section apply to ROW authorizations for renewable energy. However, specific impacts to renewable energy from management under the alternatives are discussed in Section 4.6.2 *Renewable Energy*. This section focuses on how management actions could impact ROWs and corridors by increasing, limiting, or preventing the potential for these authorizations.

The most common type of adverse impact to ROWs results from restrictions that limit or prohibit the location of ROWs or corridors because of other resource values and objectives. Adverse impacts result from implementing management actions that influence or modify the location, size, or design of an ROW authorization, require substantial mitigation, or, in some cases, preclude approval of the application. Beneficial impacts to ROWs and corridors result from management actions that increase the area available for ROWs and reduce restrictions on ROW authorizations. Direct impacts to ROWs and corridors can result from management actions that allocate an area for ROW avoidance/mitigation or exclusion, or management actions that designate specific ROW corridors or concentration areas. Indirect impacts to ROWs and corridors can result from management that results in subsequent restrictions on ROW authorizations, such as management for resource values or uses that require mitigation, relocation, or denial of ROW authorizations. All impacts to ROWs would be long-term.

4.6.3.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- ROW grants will be directly proportional to the development of other resources and resource uses in the Planning Area.
- In terms of major utility lines, companies would focus first on the maintenance and upgrading of existing lines before undertaking new construction of major utility lines in the Planning Area.
- New construction of major infrastructure and utility facilities will be based on public need and demand.
- ROWs will be granted to qualified individual, business, or government entities in a manner which protects natural resources associated with public lands and adjacent lands, whether administered by the government or a private entity (43 CFR 2801).
- At ROW renewal, existing ROWs would be allowed to continue without cost prohibitive restrictions, where appropriate. In general grants would be allowed to continue under existing constraints.
- Existing ROWs and communication sites would be managed to protect valid existing rights.

- If the current rate of ROW development continues, designated corridors should adequately meet future needs over the life of the plan. Under this rate of development, corridors may eventually be more intensely used, but crowding is not anticipated.
- ROW corridors and communication site concentration areas are designated as the preferred future locations for ROWs.
- ROW authorizations would require the appropriate level of site-specific environmental analysis.

4.6.3.2 Summary of Impacts by Alternative

Impacts to ROWs and corridors would result from management actions that limit, prohibit, or increase the potential for ROWs and include the management of ROW avoidance/mitigation and exclusion areas, ROW corridors, and resource specific restrictions and stipulations on surface-disturbing activities and ROW authorizations. ROW avoidance/mitigation and exclusion areas would both result in adverse impacts by prohibiting or limiting the development of ROWs and potentially resulting in additional constraints, mitigation, and other stipulations. ROW avoidance/mitigation and exclusion areas are the greatest under Alternative B (2,943,367 acres), followed by Alternative D (2,551,205 acres), Alternative C (1,182,097 acres), and Alternative A (1,003,194 acres). Alternative A includes the most area allocated for ROW corridors (788,275 acres) which would reduce the potential for resource conflict and additional mitigation or modification of ROW facilities, followed by Alternative C (133,284 acres) and D (132,219 acres), with Alternative B allocating the least (90,458 acres). Restrictions on surface-disturbing activities resulting from management of resources and special designations would be greatest under Alternative B. Overall, Alternative C has the lowest level of constraints applied to ROW authorizations and may result in the greatest number of new ROWs and communication sites. Alternative B includes the most constraints that would limit or prohibit ROW authorizations and would result in the least number of new ROWs and communication sites.

4.6.3.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Closing areas to locatable mineral or oil and gas development may reduce request for ROWs and other land use authorizations. However, closure of these areas may concentrate ROWs in other parts of the Planning Area that are open to mineral exploration and development.

All alternatives include limitations and restrictions on surface-disturbing activities, including ROWs. Restrictions on surface-disturbing activities result in long-term adverse impacts to ROWs by limiting or prohibiting the authorization of ROWs or corridors to meet other resource objectives. Limitations and restrictions on ROWs may also require modification of the location, size, or design of facilities associated with a ROW grant. Management of ROWs in areas with limitations on surface-disturbing activities may require additional mitigation and monitoring to ensure ROW development and operation is in accordance with established resource management objectives.

Managing ROW exclusion areas would result in long-term impacts to ROWs and corridors by prohibiting or limiting ROWs in these areas. Management of ROW exclusion areas may prohibit the location of ROWs along the most direct route for the intended purpose (for linear infrastructure such as transmission lines). This may result in increased potential for additional ROW authorizations in other locations.

Allocating ROW avoidance/mitigation areas would increase mitigation costs to ensure that development is consistent with management objectives for other resources. Managing ROW avoidance/mitigation

areas would result in long-term adverse impacts to ROWs by limiting the development of ROWs in these areas and potentially placing additional constraints, mitigation, monitoring, and other stipulations on any ROWs that are approved in avoidance/mitigation areas. All alternatives manage the following areas as ROW avoidance/mitigation areas:

- Areas having a 25 percent slope or greater
- Cave and karst areas
- The Spanish Point Karst ACEC
- WSAs

Under all alternatives, providing reasonable access through ROW authorizations on BLM-administered land for access to private land would result in long-term beneficial impacts by allowing ROW authorizations to private landowners and preventing potential trespass and illegal access issues.

Requiring on-the-ground surveys, resource inventories, and site-specific NEPA analysis prior to any surface-disturbing activity (including ROW authorizations) could require modification to the location, size, or design of facilities and infrastructure or, in some cases, preclude approval of the proposal. These adverse impacts would primarily occur from the implementation of management actions designed to protect resources and limit impacts to those resources from surface-disturbing activities. Management that results in the relocation or redesign of proposed ROWs would increase processing timeframes related to ROW authorizations. This impact would be further increased if relocation resulted in longer linear routes or placement of ROWs in areas that are difficult to develop. If avoidance of sensitive resources is not possible, other mitigation measures would be required, such as application of height and color specifications that serve to redesign ROWs to meet the goals and objectives for other resources.

Management of recreation management areas (SRMAs and ERMAs) and special designations including ACECs and WSRs would affect ROW authorizations in these areas by applying restrictions and stipulations on surface-disturbing activities and ROW development consistent with management objectives. Management prescriptions in these areas generally limit the location of ROWs or prescribe mitigation, BMPs, or monitoring to minimize adverse impacts from development and operation.

Mitigation measures, surface use restrictions, and timing limitations on surface disturbance in wildlife, threatened and endangered species, and riparian habitat would have long-term impacts to ROWs by prohibiting or limiting the potential for ROW authorizations in these areas. Limiting or prohibiting ROW authorizations in these areas may induce ROW authorizations in other areas to meet public use and demand. Seasonal timing limitations for surface-disturbing activities (including ROWs) in wildlife habitat could cause additional adverse impacts to ROWs by requiring construction activities to start and stop at certain times of the year; which could increase costs associated with ROW development.

Management to meet VRM objectives could affect the location, route, height, and color of proposed ROWs and associated facilities. Additional effort would be required to design projects to meet the objectives of the specific VRM class designation of an area in which a ROW is proposed. Because ROWs would generally be compatible with VRM Class IV objectives, this classification would allow increased opportunities for ROW authorizations. This is also true for VRM Class III objectives; however, some additional project planning may be necessary in VRM Class III areas to ensure that the landscape is partially retained. Surface-disturbing activities in areas managed as VRM Class II and VRM Class I would be limited or would require mitigation to minimize visual contrasting elements of projects. Under all alternatives, VRM objectives would be considered before authorizing land uses that may affect the

visual character of the landscape. VRM class allocations by alternative would potentially limit or prevent ROW authorizations and are discussed below under each alternative.

Designating ROW corridors could benefit ROW authorizations associated with minerals development and major utility projects. ROW development would benefit from placement in a corridor where land use conflicts have been eliminated or reduced. Designated corridors are intended to reduce resource and land use conflicts as much as possible; which could reduce the potential for modification, or mitigation needed to approve a ROW and develop infrastructure and facilities. Designating and preferring the location of ROW authorizations in corridors could also create adverse impacts to ROWs by preventing the location of ROWs along the most direct route for the intended purpose, or preventing additional ROW authorizations in a corridor if the maximum safe density of existing powerlines or pipelines is reached. This may result in increased potential for additional ROW authorizations and additional resource surveys and site-specific environmental analysis; which could increase costs and timeframes for ROW authorization and development.

Alternative A

Resource Uses

Under Alternative A, a total of 788,275 acres of BLM-administered surface are designated for ROW corridors (Map 51). Designating ROW corridors would result in impacts similar to those described under Impacts Common to All Alternatives.

Under Alternative A, a total of 941,778 acres are managed as ROW avoidance/mitigation areas (Map 51). Allocation of ROW avoidance/mitigation areas would result in long-term adverse impacts by limiting ROW authorizations in these areas. Under Alternative A, the BLM designates a total of 61,416 acres as ROW exclusion areas (Map 51). Managing ROW exclusion areas can result in long-term adverse impacts by prohibiting ROW authorizations in these areas.

Avoiding the placement of aboveground facilities such as powerlines along major transportation routes would result in long-term impacts to ROWs by limiting the location of aboveground facilities along already disturbed areas. Therefore, ROW authorizations may be more likely to be developed in previously undisturbed areas, which may require additional resource inventories and surveys before ROW authorization, and depending on the presence of resources, additional mitigation and monitoring.

Under Alternative A, a case-by-case development of renewable energy could result in a distributed pattern of renewable energy development and require additional ROW authorizations to support required infrastructure, such as transmission lines, to distribute the energy.

Special Designations

Management of ROW avoidance/mitigation and exclusion areas in ACECs and other special management areas would result in adverse impacts to ROWs by limiting or prohibiting ROW authorizations in these areas. Under Alternative A, the BLM manages the fossil concentration area of the Big Cedar Ridge ACEC as a ROW exclusion area and management in ACECs would result in 68,095 acres of ROW avoidance/mitigation areas. Prohibiting surface-disturbing activities (including construction and development of ROWs) above cave and cave passages in the Sheep Mountain Anticline ACEC would result in adverse impacts to ROWs by prohibiting authorizations in these areas.

Avoiding surface-disturbing activities within ¼ mile of the Nez Perce NHT would result in adverse impacts to ROWs by limiting ROW authorizations in these areas. Avoiding surface-disturbing activities in the immediate vicinity of significant cultural resources and canals and in view within ¼ mile of significant

segments of the Bridger Trail and the Fort Washakie to Meeteetse to Red Lodge Trail would also result in adverse impacts to ROWs by limiting ROW authorizations in these areas.

Resources

Prescribing specific timing limitations under Alternative A could eliminate the potential for discretionary seasonal limitations when reviewing and approving ROW authorizations. Additionally, avoiding or excluding surface-disturbing activities (including ROWs) during portions of the year may limit the development of ROWs in these areas by creating start/stop cycles in construction and operation that may make projects infeasible. Under Alternative A, the following areas include timing limitations for ROW avoidance/mitigation or exclusion:

- Big game crucial winter range (1,313,731 acres) from November 15 through April 30
- Big game parturition habitat (81,770 acres) from May 1 through June 30
- Greater sage-grouse nesting and early brood-rearing habitats within 2 miles of occupied greater sage-grouse leks (1,009,963 acres) or in identified greater sage-grouse nesting and brood-rearing habitat outside the 2-mile buffer from March 15 to July 15 (February 1 to July 31 in CYFO)
- Greater sage-grouse winter concentration areas from November 15 to March 14
- Within ¾-mile radius of any active raptor nest sites (338,731 acres) from February 1 through July 31

Managing VRM Class I (141,110 acres) and VRM Class II (339,205 acres) areas may result in adverse impacts to ROWs by limiting development that would not meet associated VRM objectives or may require specific design or mitigation guidelines for ROW authorization.

Alternative B

Resource Uses

Under Alternative B, a total of 90,458 acres of BLM-administered surface are designated for ROW corridors (Map 52). Management of ROW corridors would result in similar impacts as under Alternative A, although to a lesser extent because Alternative B would designate 697,817 fewer acres as ROW corridors compared to Alternative A.

Alternative B manages a total of 2,717,617 acres as ROW avoidance/mitigation areas (Map 52). Managing ROW avoidance/mitigation areas would result in adverse impacts similar to Alternative A, although to a greater extent because Alternative B manages 1,775,839 more acres as ROW avoidance/mitigation areas than Alternative A. Alternative B manages a total of 225,750 acres as ROW exclusion areas (Map 52). Managing ROW exclusion areas would result in adverse impacts similar to Alternative A, although to a greater extent because Alternative B manages 164,334 more acres as ROW exclusion than Alternative A. Alternative B manages more area as ROW avoidance/mitigation and exclusion areas than the other alternatives. Therefore, Alternative B likely would result in a greater concentration of linear ROWs on and through private lands than the other alternatives.

Under Alternative B, prohibiting communication sites in all avoidance/mitigation and exclusion areas and requiring the co-location of sites would create long-term impacts to ROWs. ROW avoidance/mitigation and exclusion areas comprise a large portion (2,943,367 acres) of the Planning Area under Alternative B, and prohibiting communications sites in these areas could prevent the location of these sites in operator-preferred locations. As a result, additional ROWs and associated

facilities may be required in less than optimal locations, from an operator's perspective, to meet the goals and objectives of a project and meet community expansion and telecommunications needs.

Concentrating aboveground facilities along major transportation routes would have long-term impacts on the lands and realty program by encouraging ROW development in already disturbed areas, which may decrease potential mitigation and monitoring and reduce processing time. Conversely, preferring concentration of aboveground facilities in these areas, along with prohibiting construction in ROW exclusion areas and limiting these facilities in ROW avoidance/mitigation areas, may prevent the location of aboveground facilities along the most direct route for the intended purpose. This may result in increased potential for additional ROW authorizations, and associated resource surveys and site-specific environmental analysis, which could increase costs and time for ROW authorization and development.

Considering night skies in the evaluation of ROW applications and applying BMPs as appropriate could increase the processing time and costs for ROWs and potentially limit the approval of ROW authorizations when impacts cannot be adequately mitigated.

Special Designations

Managing ROW avoidance/mitigation and exclusion areas in ACECs and other Management Areas would result in adverse impacts similar to Alternative A, although to a greater extent because Alternative B would designate more ACECs. Under Alternative B, management in ACECs would result in 57,066 acres of ROW exclusion areas and 242,891 acres of ROW avoidance/mitigation areas. Alternative B includes the greatest amount of ROW avoidance/mitigation and exclusion areas in ACECs compared to the other alternatives. Prohibiting surface-disturbing activities (including construction and development of ROWs) above cave and cave passages in the Sheep Mountain Anticline ACEC would result in the same adverse impacts as those described under Alternative A. Designating all LWCs as Wild Lands under Alternative B would result in long-term impacts to ROWs by avoiding or prohibiting surface-disturbing activities in these areas.

Management for NHTs and Other Historic Trails would result in adverse impacts to ROWs similar to Alternative A, although to a greater extent because Alternative B avoids surface-disturbing activities in a larger area (within 5 miles of the Nez Perce NHT and Other Historic Trails). Exempting existing utility corridors from this restriction within 5 miles of other trails may reduce adverse impacts to ROW corridors compared to Alternative A.

Under Alternative B, avoiding surface-disturbing activities in view within 5 miles of Heart Mountain Relocation Center National Historic Landmark would result in adverse impacts by limiting ROW authorizations in these areas or requiring mitigation or other stipulations to minimize impacts to Heart Mountain.

Prohibiting surface-disturbing activities in all WSR suitable waterway segments would result in adverse impacts to ROWs by preventing ROW authorizations in these areas.

Resources

Mitigation measures, surface-use restrictions, and timing limitations on surface disturbance in wildlife, threatened and endangered species and riparian habitat would result in impacts similar to Alternative A, although to a greater extent because Alternative B places more restrictions on surface-disturbing activities in these areas and has more areas with restrictions.

Alternative B manages big game crucial winter range (1,313,731 acres) and parturition habitat (81,770 acres) as ROW avoidance/mitigation areas. There would be more adverse impacts to ROWs in these areas than under Alternative A because Alternative B avoids areas year-round.

Under Alternative B, impacts to ROWs from management of greater sage-grouse would be similar to Alternative A, although to a greater extent because Alternative B has more year-round restrictions and larger buffer areas associated with timing limitations. Alternative B manages the following areas as ROW mitigation or exclusion areas:

- Within 0.6 mile of occupied greater sage-grouse leks (157,008 acres)
- Within 3 miles of occupied greater sage-grouse leks (1,571,115 acres) or in identified nesting and early brood-rearing habitat outside the 3-mile buffer from February 1 through July 31
- Greater sage-grouse winter concentration areas
- Greater sage-grouse Key Habitat Areas (1,231,383 acres)

Timing limitations for the protection of nesting raptors would result in impacts similar to Alternative A, although to a greater extent because Alternative B includes larger buffer areas associated with timing limitations.

Managing the Absaroka front as an ROW avoidance/mitigation area (106,354 acres) would result in adverse impacts to ROWs by limiting authorizations in this area or requiring mitigation and monitoring to reduce adverse impacts to resource values.

Avoiding surface-disturbing activities (including ROW authorizations) in view within 5 miles of important cultural sites where the integrity of setting is a contributing element of NRHP significance may result in adverse impacts to ROWs, especially major ROWs that have larger surface disturbance and higher potential to affect the integrity of setting. Exempting designated utility corridors from this restriction would reduce impacts to linear ROWs in designated corridors. Under Alternative B, management of cultural resources would have greater adverse impacts to ROWs than any other alternative.

Impacts from VRM would be similar to those under Alternative A, except more area is managed as VRM Class I (154,343 total acres) and VRM Class II (1,782,843 total acres); which would increase the restrictions designed to protect visual resources and would subsequently decrease opportunities for ROW authorizations in these areas.

Alternative C

Resource Uses

Alternative C designates a total of 133,284 acres of BLM-administered surface for ROW corridors (Map 53). Impacts to ROWs from the designation of ROW corridors would be less than under Alternative A, although to a lesser extent because Alternative C designates 654,991 fewer acres for ROW corridors. Alternative C has more area designated for ROW corridors than alternatives B and D, but less than Alternative A.

Alternative C manages a total of 1,174,335 acres as ROW avoidance/mitigation areas and 7,762 acres as ROW exclusion areas (Map 53). Managing ROW avoidance/mitigation would result in impacts similar to Alternative A, although to a greater extent because Alternative C manages 232,557 more acres as ROW avoidance/mitigation areas. Conversely, Alternative D manages 53,654 less acres as ROW exclusion areas compared to Alternative A, reducing impacts to ROWs from this management restrictions compared to that alternative. Alternative C manages more area as ROW avoidance/mitigation or exclusion areas than Alternative A, but fewer than alternatives B and D.

Avoiding the placement of aboveground facilities such as powerlines along major transportation routes under Alternative C would result in the same long-term impacts as Alternative A.

Special Designations

Management of ACECs would result in adverse impacts similar to Alternative A by limiting authorizations in these areas, although to a lesser extent because Alternative C manages only two ACECs. Management in the Spanish Point Karst ACEC would create 6,627 acres of ROW avoidance/mitigation area, the least ROW avoidance/mitigation and exclusion areas in ACECs compared to the other alternatives.

Avoiding surface-disturbing activities within ¼ mile of the Nez Perce NHT would result in impacts similar to Alternative A. Avoiding surface-disturbing activities in view within ¼ mile of other trails would result in impacts similar to Alternative A, although to a greater extent. Alternative C includes all regionally important prehistoric and historic trails (i.e., Other Historic Trails); Alternative A includes only significant segments of the Bridger Trail and the Fort Washakie to Meeteetse to Red Lodge Trail. Exempting existing utility corridors from this restriction would further reduce adverse impacts compared to Alternative A. Management of NHTs and other trails would result in fewer adverse impacts to ROWs than alternatives A and B.

Resources

Exempting Oil and Gas Management Areas (Map 21) and ROW corridors (Map 53) from seasonal stipulations would have long-term beneficial impacts to ROWs and corridors by increasing the potential for authorizations in these areas, allowing year-round construction, and eliminating the potential for discretionary seasonal limitations applied to ROW authorizations in these areas. Mitigation measures, surface use restrictions, and timing limitations on surface disturbance in wildlife, threatened and endangered species, and riparian habitat would result in fewer impacts than Alternative A because Alternative C includes fewer restrictions in these areas.

Under Alternative C, there would be fewer adverse impacts to ROWs from management of greater sage-grouse than any other alternative because Alternative C includes smaller buffer areas and shorter periods associated with seasonal limitations.

Under Alternative C, there would be fewer adverse impacts to ROWs from management of raptor nests than under the other alternatives because Alternative C includes a smaller buffer area (¼ mile) associated with seasonal restrictions.

Managing cultural resources would result in adverse impacts to ROWs similar to Alternative B, although to a lesser extent because Alternative C reduces the avoidance/mitigation area to a ¼-mile buffer. Under Alternative C, there would be fewer adverse impacts to ROWs from managing cultural resources than under any other alternative.

Under Alternative C, impacts from VRM would be similar to Alternative A, except Alternative C manages less area as VRM Class I (140,958 acres) and VRM Class II (330,020 acres). This would decrease the level of restrictions designed to protect visual resources and may increase opportunities for ROW authorizations in the Planning Area.

Alternative D

Resource Uses

Alternative D manages a total of 132,219 acres of BLM-administered surface for ROW corridors (Map 54). Alternative D would result in impacts to ROWs from the designation of ROW corridors similar to

those described under Alternative C, because the alternatives designate similar amounts of area for ROW corridors. Alternative D has more area designated for ROW corridors than Alternative B, but less than Alternative A.

Alternative D manages a total of 2,512,202 acres as ROW avoidance/mitigation areas (Map 54). Designating these avoidance/mitigation areas would cause adverse impacts similar to Alternative A, although to a greater extent because Alternative D designates 1,570,424 more acres than Alternative A.

Alternative D manages a total of 39,003 acres as ROW exclusion areas. Managing these exclusion areas would result in impacts similar to Alternative A, although to a lesser extent because Alternative D designates 22,413 fewer acres than Alternative A. Alternative D has more area managed as ROW exclusion area than Alternative C, but less than alternatives A and B.

Avoiding the placement of aboveground powerlines in the areas identified under Alternative D would result in adverse impacts to linear ROWs by limiting these authorizations in the identified areas. If the BLM authorizes aboveground powerlines in these areas, specific design guidelines and mitigation may be required to reduce adverse impacts to resource values.

Considering night skies in the evaluation of ROW applications would result in the same impacts as Alternative B.

Special Designations

Managing ROW avoidance/mitigation and exclusion areas in ACECs and other management areas would result in adverse impacts similar to Alternative A, although to a greater extent because Alternative D includes more ACECs and other management areas and more acreage of these areas. Under Alternative D, management in ACECs would result in 264 acres of ROW exclusion areas and 82,395 acres of ROW avoidance/mitigation areas. ACEC and Wild Lands designations under Alternative D would result in more ROW avoidance/mitigation and exclusion areas compared to alternatives A and C, but less than Alternative B. Allowing minor ROW authorizations and other minor surface-disturbing activities in the Clarks Fork Basin/Polecat Bench West Paleontological ACEC and the Foster Gulch Paleontological ACEC only if preceded by a paleontological survey may result in adverse impacts by limiting ROW authorizations in these areas. Designating the Chapman Bench Management Area would result in 3,425 acres of ROW avoidance/mitigation area. Prohibiting surface-disturbing activities (including ROW construction and development) above caves and cave passages in the Sheep Mountain Anticline ACEC would result in adverse impacts similar to Alternative A.

Prohibiting development with a moderate or strong contrast in the viewshed of the Heart Mountain Relocation Camp would result in adverse impacts similar to Alternative B, although to a greater extent because Alternative B only avoids surface-disturbing activities in view within 5 miles of the Heart Mountain National Historic Landmark. However, under Alternative D, the BLM may authorize more ROWs that could result in less than moderate contrast in this area compared to Alternative B.

Avoiding surface-disturbing activities up to 3 miles from the NHT (and 2 miles from Other Historic Trails) where the setting is an important aspect of the trail would cause impacts to ROWs similar to Alternative B, although to a lesser extent because Alternative D includes less acreage (distance from NHT and Other Historic Trails). Similar to alternatives B and C, exempting these restrictions in existing utility corridors would reduce these impacts in ROW corridors. Under Alternative D, management of NHTs and historic trails would result in greater adverse impacts to ROWs than alternatives A and C, but less than Alternative B.

Resources

Impacts to ROWs from management of big game crucial winter range and parturition habitat would be similar to Alternative A, although to a lesser extent because of the exemption of Oil and Gas Management Areas from discretionary big game seasonal limitations.

Impacts to ROWs from management of greater sage-grouse would be greater than under Alternative A, because Alternative D includes more restrictions and timing limitations inside and outside greater sage-grouse Key Habitat Areas.

Management of raptor nests would result in similar adverse impacts to ROWs as under Alternative A, although to a lesser extent because Alternative D includes less acreage associated with restrictions and seasonal limitations. Under Alternative D, there would be more impacts from management of raptor nests than under Alternative C, but less than under alternatives A and B.

Managing the Absaroka Front Management Area with measures to protect wildlife habitat would cause adverse impacts similar to Alternative B.

Management of cultural resources would result in adverse impacts to ROWs similar to Alternative B, although to a lesser extent because Alternative D includes less avoidance/mitigation area (3 miles). Under Alternative D, adverse impacts to ROWs from management of cultural resources would be less than Alternative B, but greater than Alternative C.

Impacts from VRM would be similar to those under Alternative A, except that Alternative D manages more area as VRM Class II (638,929 total acres), which may increase the restrictions designed to protect visual resources and would subsequently decrease opportunities for ROW authorizations in these areas. Compared to the other alternatives, Alternative D includes more area designated as VRM Class I and VRM Class II than alternatives A and C, but less than Alternative B.

4.6.4 Comprehensive Travel and Transportation Management

This section describes potential impacts to access and travel management from managing other resources or resource uses. The CTTM program operates as a support program, rather than a resource in and of itself, because it supports other management activities in the Planning Area. The CTTM program addresses planning for OHV activities and other motorized vehicle use, and the travel needs for all BLM-administered resource management programs for such activities as mineral extraction, livestock grazing, habitat enhancement projects, and recreation. The program responds to a need to maintain an adequate transportation system to provide access to and use of public land resources. Travel designations for motorized travel (open, limited, closed) include off-road vehicles.

For the purposes of this analysis, adverse impacts to travel and transportation management are those that restrict travel (e.g., managing areas as closed or limited to motorized travel, or road closures). In general, adverse impacts to CTTM are greater when areas are closed to motorized travel than when travel is limited. Management limiting motorized travel to designated roads and trails is more restrictive than limiting travel to existing roads and trails and would therefore result in greater adverse impacts to CTTM. Limiting travel to designated roads and trails only allows motorized vehicle use in areas defined with specific signage or areas identified in travel management plans. Beneficial impacts result from management that increases the number or quality of roads and trails, or that provides opportunities for access on- or off-road using motorized, mechanized, equestrian, or foot travel. Beneficial impacts also include improvements to travel that reduce potential health and safety concerns associated with travel and transportation use in the Planning Area.

This section does not address the adverse or beneficial impacts of travel and transportation management on other resources and resource uses. While impacts from travel and transportation management to other program areas do occur and are considered as part of travel management planning, in this RMP, these types of impacts are described under the resource or resource use affected by this management. For example, Section 4.4.6 *Wildlife* addresses the impacts to elk of seasonal closures in elk parturition habitat, while this section addresses the impacts of this restriction to access and travel across BLM-administered lands.

Direct impacts to CTTM include actions that restrict or enhance road or trail use in the Planning Area. Direct impacts include closures or rerouting of trails and roads due to safety concerns such as shooting ranges and H_2S-related health concerns. Indirect impacts result from management that limits, restricts, or enhances development or activities that require travel and transportation use and access (e.g., ROW development, recreation, withdrawals).

4.6.4.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Analysis assumes that within 5 years of the completion of the RMP revision, travel management plans will have been completed by the CYFO and WFO. These would include inventories of roads and the establishment of authorized travel networks for all means of travel.
- OHV use is motor vehicle use of the non-highway road and trail network on public lands. It includes all resource-related activities, including recreation and those associated with livestock grazing and mineral development.
- The analysis assumes OHV designations are to be fully implemented 5 years after approval of this RMP.
- The greater the area of authorized roads open to motorized vehicles, the greater the benefit to travel management. Reductions to road density result in beneficial impacts to some resources (e.g., big game, soils), but may require additional effort for users (e.g., longer travel routes).
- Demand for new ROWs or access is expected to decrease because there is existing infrastructure. ROW applications for energy related transportation facilities (e.g., roads, pipelines) are expected to increase with the number of RFDs.
- Existing ROWs granted to other parties for access across the public lands are not affected by this RMP.
- The average road width is 12 feet.

4.6.4.2 Summary of Impacts by Alternative

Impacts to CTTM result from travel designations that open, limit, or close areas to travel. Additional impacts result from management that affects the number or quality of roads and trails or management that affects opportunities for access on- or off-road using motorized, mechanized, equestrian, or foot travel.

Alternative C would result in the most new road and trail development, primarily due to the larger acreage open to cross-country motorized travel, followed by alternatives D, B, and A. Under alternatives B and D, the BLM specifically establishes the most new trails and roads for motorized, mechanized, and primitive recreational uses, but does not manage as many acres as open to cross-country motorized travel as under Alternative C.

ROW exclusion areas would prevent the construction of new roads authorized through a ROW permit that could be used for motorized vehicle use. ROW exclusion areas would restrict the development of new travel routes most under Alternative B, followed by alternatives A, D, and C.

Alternative B includes the most limitations on and closures to motorized and mechanized vehicle use for resource protection. Therefore, this alternative would cause the greatest adverse impacts to access opportunities for motorized vehicle use, followed by alternatives D, A, and C. Alternative B limits the most acreage to designated roads and trails in the Planning Area (2,054,228 acres), followed by alternatives D (1,055,257 acres), C (951,992 acres), and A (787,626 acres). The area limited to existing roads and trails is greatest under Alternative A (2,332,355 acres) followed by C (2,144,623 acres), D (2,028,620 acres), and B (931,803 acres). Alternative B closes the greatest acreage to motorized vehicle use (136,474 acres), followed by alternatives D, A, and B, which close 60,681, 59,192, and 10,636 acres, respectively. Due to the size of the Planning Area and the limited number of new projected roads, restrictions on motorized and/or mechanized travel on existing routes may have a greater effect on travel and transportation management than the miles or location of new road development.

Overall, Alternative C would cause the fewest adverse impacts (and the most benefits) to CTTM, followed by alternatives A, D, and B.

4.6.4.3 Detailed Analysis of Alternatives

Each of the alternatives includes an increase in the level of travel management planning to improve travel management in the Planning Area. Certain resource management actions would result in adverse impacts to CTTM by placing limitations on the development of new routes or limiting access to portions of the Planning Area in ways that affect the ability to meet multiple-use objectives.

Impacts Common to All Alternatives

Management of resources and resource uses that affect travel and transportation management include mineral resources, recreation, special designations, soil, water, cave and karst resources, fish and wildlife resources, special status species, cultural resources, and paleontological resources. Appendix R includes a travel designation matrix that describes specific travel management designations by area. Unless otherwise specified, motorized vehicle use is limited to existing roads and trails on BLM-administered land under all alternatives.

Increased development for oil and gas and other minerals would modify the road network by creating new travel routes, which would provide new travel and access opportunities throughout the Planning Area. Under Alternative A, approximately 50 percent of anticipated new road development would be oil and gas related (Appendix T), and this development would increase access and provide opportunities for recreational travel, particularly for OHVs. Routine and emergency maintenance of these roads would be required to maintain access and to ensure that the roads are maintained and used in accordance with other resource objectives. After mineral activities conclude and a road is no longer needed for the authorized purpose, a review would determine if the road meets BLM travel management objectives. If the road does not meet the needs and objectives of the BLM transportation system in the Planning Area or does not provide access for multiple use or administrative use, the operator would be required to reclaim the road. The development of mineral resources may adversely impact CTTM by creating hazardous conditions, noxious odors, and dangerous gas (such as H_2S).

Management for other resources including vegetation, cultural resources, special status species, and paleontological resources may result in adverse impacts to CTTM by restricting trails or limiting use for the protection of resource values. Some special designations (such as ACECs) and areas with important

resource values (such as some educational trails or special status species habitat) restrict motorized vehicle use and other forms of travel under all the alternatives. Such restrictions would generally result in adverse impacts to CTTM by limiting or restricting travel in these areas.

Limiting motorized travel to designated roads and trails would limit travel to areas specifically designated for travel through appropriate signage or other methods. Although limiting motorized travel to designated roads and trails would result in greater adverse impacts to CTTM than limiting travel to existing roads and trails, travel would still be allowed in these designated areas. Under all alternatives, motorized vehicle use is limited to designated roads and trails in the following areas:

- Over important caves or cave passages
- Medicine Lodge and Upper Renner Wildlife Habitat Areas (with a seasonal closure)
- Essential and recovery habitat for threatened or endangered species
- Areas containing significant cultural and paleontological resources
- Bald Ridge Area (with a seasonal closure)
- Twin Creek Trail (with a seasonal closure)
- Carter Mountain area (with a seasonal closure)
- Little Mountain area (with a seasonal closure on a portion of the area)
- The Brown/Howe Dinosaur Area ACEC
- Upper Nowood and South Brokenback areas
- LU Sheep Company cooperative area
- Rattlesnake Mountain
- McCullough Peaks Area

Closing areas to motorized vehicle use would cause the greatest adverse impacts to travel and transportation use compared to other travel limitations (limited to existing, limited to designated, seasonal restrictions) by prohibiting use in certain areas. Under all alternatives, the following areas are closed to motorized vehicle use:

- Spanish Point Karst ACEC
- Duck Swamp-Bridger Trail Environmental Education Area
- Salt Lick Trail
- Gooseberry Badlands Interpretive Trail
- Paint Rock Trail
- Lone Tree Trail
- Canyon Creek Access Trail
- Bald Ridge Area (seasonal)
- Canada lynx analysis units (LAUs)
- Cottonwood Creek Trail
- Pete’s Canyon Trail
- Five Springs Road (old roadbed portion)

Under all alternatives, travel designations, closures, or routing of roads and trails in areas that pose health and safety risks would result in long-term impacts to CTTM. Areas closed year-round to

motorized and mechanized vehicle use to protect visitor safety include the Cody Shooting Complex, the Lovell shooting range, the rifle range west of Worland, and the Cody Archery Range.

Under all alternatives, implementing existing travel management plans in the following areas would benefit CTTM by providing site-specific travel designations that accommodate appropriate access while considering resource protection and user safety:

- McCullough Peaks
- Carter Mountain ACEC
- Little Mountain
- Upper Nowood
- South Brokenback
- Renner (Upper and Lower) Wildlife Habitat Management Units
- Medicine Lodge Wildlife Habitat Management Units
- Paint Rock Area
- Cooperative Agreement with LU Sheep Company
- Rattlesnake Mountain

Under all alternatives, LAUs are closed to over-snow travel, which would result in adverse impacts to CTTM by restricting travel in these areas.

Implementing the site-specific management documented in travel management plans would benefit the specific goals described in these documents, such as minimizing impacts to resources (e.g., soils) or protecting the characteristics of specially designated areas (e.g., WSAs). Travel management plans developed subsequent to this RMP would benefit CTTM by addressing the maintenance and use of roads and trails considering site-specific conditions.

Allowing pedestrian and equestrian travel on or off roads and trails, except for limited seasonal restrictions for the protection of resources in the Bald Ridge Area, would benefit CTTM by allowing these types of travel throughout the Planning Area.

Restrictions and limitations on surface-disturbing activities associated with water quality, watershed, and soils management, would result in adverse impacts to CTTM by restricting or limiting the development of new roads for the protection of these resources.

Alternative A

Resource Uses

Alternative A would result in approximately 574 miles (835 acres) of new road and trail creation due to user-pioneered routes in areas open to cross-country motorized travel and new BLM-created routes. Additionally, the BLM anticipates 1,351 miles (1,966 acres) of short-term road creation, of which 675 miles (983 acres) is anticipated to remain in the long term following reclamation (Appendix T). These roads would primarily result from ROW authorizations related to mineral and other facility developments under this alternative.

New recreational roads and trail development and improvements to the existing travel network would result in beneficial impacts by increasing opportunities for motorized recreational use and maintaining or improving the quality of existing routes. Specific new road and trail management actions that would result in beneficial impacts include developing scenic driving loops in the Badlands SRMA, and access

improvements in the Trapper Creek, Paint Rock, South Bighorns, and Canyon Creek areas, which includes road and trail maintenance, and possible new trail and route construction to enhance access. Alternative A opens 1,320 acres to off-road motorized vehicle use.

Management of ROW avoidance/mitigation and exclusion areas would result in long-term impacts to travel and transportation management by limiting or restricting the development of roads authorized through a ROW permit, and by restricting the routing of new roads. Alternative A manages 941,778 acres as ROW avoidance/mitigation areas and 61,416 acres as ROW exclusion areas.

Recreation management areas would result in long-term impacts to travel and transportation by prescribing travel designations in these areas. Under Alternative A, motorized vehicle use in SRMAs and ERMAs is generally limited to existing or designated roads and trails (see Appendix R). The WSAs in the Badlands SRMA are the only recreation-related management areas closed to motorized vehicle use managed for their wilderness characteristics (e.g., outstanding opportunities for solitude, and primitive and unconfined recreation) that may not be compatible with motorized vehicle use.

Special Designations

Alternative A restricts motorized travel to protect resources and values in special designations (ACECs, WSAs, WSRs, NHTs). These restrictions limit motorized vehicle use in these areas or close all or certain portions of an area, which would affect CTTM.

Of the nine ACECs designated under this alternative, seven limit motorized vehicle use to designated roads and trails (with a seasonal closure in the Carter Mountain ACEC); Alternative A limits motorized travel in the Big Cedar Ridge ACEC to existing roads and trails, and the Spanish Point ACEC is closed to motorized use. Four WSAs are closed to motorized vehicle use, with use limited to existing roads and trails in the Cedar Mountain and Honeycombs WSAs, and limited to designated roads and trails in the Alkali Creek, McCullough Peaks, Medicine Lodge, and Trapper Creek WSAs. Most of the WSR eligible waterway segments are managed to limit motorized vehicle use to designated roads and trails or close the areas to motorized vehicle use. Management under Alternative A includes avoidance of surface-disturbing activities in view within ¼ mile of the Nez Perce (Neeme-poo) NHT and Other Historic Trails, which would restrict the construction of new roads, but does not specifically close motorized use (managed as limited to existing roads and trails).

Resources

Travel designations (e.g., seasonal restrictions) and mitigation measures to protect wildlife resources and threatened and endangered species and important habitats would restrict the timing of surface-disturbing and other disruptive activities, which would limit or restrict the development of new roads.

Under Alternative A, requiring the closure of spur roads after completion of timber management practices and limiting motorized vehicle use to designated roads and trails in areas with fragile soil, which may require the closure of some existing, undesignated routes in these areas, would result in adverse impacts to CTTM. The closure of spur roads may limit opportunities for new access if they occur in areas where routes did not previously exist.

Proactive Management

Beneficial impacts to CTTM under Alternative A would result from allowing open cross-country motorized vehicle use on 1,320 acres and over-snow travel on a case-by-case basis, and managing most of the Planning Area as limited to existing roads and trails (2,332,355 acres). The BLM manages for or tolerates cross-country motorized travel in several locations across the Planning Area, including the Worland OHV area, the Bentonite Hills area, the Lovell Lakes “Motocross” area, hill climbing areas near

Cowley, the Rattlesnake Ridge area, and the Basin Gardens area. Allowing cross-country travel in these areas and the continued management of most of the Planning Areas as limited to existing roads and trails would provide motorized and other nonmotorized travel opportunities across most of the Planning Area. In addition, travel restrictions and limitations in the Paint Rock area, Dry Farm Road area, and LU Sheep Company cooperative area, and implementation of the travel management plans in the South Brokenbacks, Renner Units, Medicine Lodge, Upper Nowood, McCullough Peaks, and Little Mountain areas would clarify routes available for travel and help to target management to meet the desired outcomes for these areas.

Allowing off-road motorized and/or mechanized vehicle use outside of the open areas to provide access for big game retrieval and campsite access would be beneficial impacts because it would increase access.

Alternative B

Resource Uses

Compared to the other alternatives, Alternative B would result in the smallest amount of new roads from ROW authorizations and the second smallest amount of new roads in locales open to cross-country motorized travel or from BLM road and trail creation. Alternative B would result in 734 miles (1,068 acres) of new road and trail creation due to user-pioneered routes in areas open to cross-country motorized travel and new BLM-created routes (Appendix T). Primarily the result of ROW authorizations, Alternative B would result in an additional 845 miles (1,229 acres) of short-term road creation, of which 422 miles (615 acres) is anticipated to remain in the long term following reclamation (Appendix T).

Alternative B would benefit CTTM through new recreational road and trail development similar to Alternative A, but to a greater extent. Alternative B includes motorized touring loops in the Trapper Creek RMZ (connecting with the Paint Rock RMZ and Bighorn National Forest), the Paint Rock RMZ (connecting with the Bighorn National Forest and the Brokenback/Logging Road RMZ), and the Brokenback/Logging Road RMZ (connecting with the aforementioned areas). Alternative B also includes more new trailheads and trails development for recreational use, such as new trails in the Canyon Creek and Horse Pasture SRMAs, to enhance mechanized and primitive forms of travel. Alternative B would result in greater beneficial impacts to CTTM from the establishment of new motorized, mechanized, and primitive travel routes than Alternative A, but less than Alternative C.

Impacts to CTTM from ROW management would result in impacts similar to Alternative A, although to a greater extent because Alternative B manages more area as ROW avoidance/mitigation and exclusion areas. Alternative B includes the largest ROW exclusion area (225,750 acres) compared to the other alternatives. As a result, Alternative B would result in the greatest adverse impacts to CTTM from restrictions and limitations on new roads and routes authorized through ROWs.

Alternative B limits most motorized vehicle use in SRMAs and ERMAs to designated roads and trails (see Appendix R). Alternative B would close the Wild Badlands RMZ (in the Badlands SRMA), and the Horse Pasture, Beck Lake, and Newton Lake Ridge SRMAs to motorized vehicle use. Closing the Rattlesnake Ridge area, which contains high levels of H_2S gas from oil and gas development that poses a substantial health risk to trail users, would cause long-term impacts to CTTM. Although the BLM would construct more trailheads and access routes under this alternative compared to the others, management of recreation areas under Alternative B would limit or close more areas to motorized travel, which would cause the greatest adverse impacts to CTTM.

Special Designations

Managing special designations under Alternative B would result in the greatest adverse impacts to CTTM compared to the other alternatives. Although the types of impacts would be similar to those under Alternative A, Alternative B places more restrictions on motorized travel to protect resources in areas with special designations than any other alternative. Overall, motorized travel restrictions in special designations under Alternative B would result in the greatest adverse impacts to access opportunities. Adverse impacts would include new constraints on access to areas that were previously accessible to motorized vehicles.

Of the 17 ACECs designated under this alternative, 14 limit motorized vehicle use to designated roads and trails (with a seasonal closure in the Carter Mountain and Rattlesnake Mountain ACECs and partial closures in the Clarks Fork Canyon and Sheep Mountain ACECs). Alternative B closes most WSR suitable waterway segments to motorized and mechanized vehicle use. The alternative closes all ACECs and WSR suitable waterway segments to over-snow motorized travel, which may adversely affect other resource programs. For example, closing the Dry Medicine Lodge WSR suitable waterway segment to motorized vehicle use would adversely affect the ability of the WGFD and others to access the Medicine Lodge Wildlife Habitat Management Area. Alternative B designates all LWCs as Wild Lands and limits motorized vehicle use to designated roads and trails in these areas, which have no specific travel designations under alternatives A and C.

Motorized vehicle use in areas in view within 5 miles of the Nez Perce (Neeme -poo) NHT and Other Historic Trails is limited to designated roads and trails, which would restrict the use of non-designated routes near the NHT more than other alternatives.

Resources

Under Alternative B, the emphasis of resource protection over resource use would result in more restrictions on motorized vehicle use compared to the other alternatives. Increased restrictions that limit or close motorized travel would result in adverse impacts to CTTM.

Travel designations (e.g., seasonal restrictions) and mitigation measures to protect wildlife resources, special status species, and important habitats would result in impacts to CTTM similar to Alternative A, although to a greater extent because Alternative B includes more restrictions in these areas. Limiting motorized vehicle use to designated roads and trails (with seasonal closures) in big game crucial winter range, elk parturition habitat, and greater sage-grouse Key Habitat Areas would adversely affect travel in these areas by restricting the use of some routes or eliminating opportunities for travel through some areas during a portion of the year. Under Alternative B, partially closing the Absaroka Front Management Area (106,354 acres) to motorized vehicle use and limiting use to designated roads and trails in the remainder of the area would result in adverse impacts to CTTM in the area by limiting travel opportunities.

Under Alternative B, closing roads used for timber access and hauling that are not required for existing uses would result in adverse impacts to CTTM by reducing available routes and access for travel.

Limiting motorized vehicle use to designated roads and trails for the protection of cultural resources in the Gebo/Crosby Area would result in adverse impacts to CTTM in this area by limiting travel opportunities.

Prohibiting off-road motorized (and/or mechanized) vehicle use for big game retrieval or dispersed campsites in areas with limited travel designations would substantially restrict access in these areas, adversely affecting CTTM more than any of the other alternatives.

Proactive Management

Beneficial impacts to CTTM under Alternative B would result from allowing open cross-country motorized vehicle use on 3,169 acres and limiting motorized vehicle use to existing roads and trails (931,803 acres). Overall, Alternative B includes the most restrictions and the fewest beneficial proactive management actions for motorized vehicle use. Under Alternative B, over-snow vehicle use would be subject to more restrictive requirements (e.g., an average of 12 inches of snow) before it would be allowed, with the special designations and wildlife habitat areas discussed previously closed entirely to this type of travel. The beneficial impacts to winter, over-snow motorized vehicle use under Alternative A would not be realized under Alternative B.

Alternative B would implement and maintain the current travel management plans identified under Impacts Common to All Alternatives and implement new travel management plans that will cover the remaining areas managed as Designated Roads and Trails. Alternative B limits motorized vehicle use to designated roads and trails on 161 percent more BLM-administered public lands than Alternative A, 116 percent more than Alternative C, and 95 percent more than Alternative D. Therefore, Alternative B would cause more adverse impacts to CTTM by limiting or closing more areas to motorized travel than would the other alternatives.

Alternative C

Resource Uses

Compared to the other alternatives, Alternative C would result in the greatest area of new roads from ROW authorizations and new roads in locales open to cross-country motorized travel or from BLM road and trail creation. Based on projected long-term surface disturbance, Alternative C would result in 8,755 miles (12,735 acres) of new road and trail creation due to user-pioneered routes in areas open to cross-country motorized travel and new BLM-created routes (Appendix T). Primarily the result of ROW authorizations, Alternative C is projected to result in 3,188 miles (4,638 acres) of short-term road creation, of which 1,594 miles (2,319 acres) would remain in the long term following reclamation (Appendix T).

Alternative C would result in similar types of beneficial impacts to motorized travel and opportunities for access from new recreational road and trail development as the other alternatives, but to a lesser extent. Alternative C establishes hiking trails in developed recreation areas and an access road at Rainbow Canyon; however, overall management under this alternative would result in the establishment of fewer new recreational travel routes compared to the other alternatives. Alternative C may result in the greatest amount of new user-pioneered roads and trails because it contains the greatest area open to cross-country motorized travel.

Impacts to CTTM from ROW management would be similar to those described under Alternative A. Alternative C includes more area designated as ROW avoidance/mitigation and exclusion compared to Alternative A, but less than alternatives B and D. As a result, adverse impacts to CTTM from ROW management would be less than alternatives B and D, but greater than Alternative A.

Most motorized vehicle use in the Planning Area (managed mostly as the Bighorn Basin ERMA) is limited to existing roads and trails under Alternative C, whereas the alternative manages the Rattlesnake Ridge SRMA and the Basin Gardens Play Area ERMA as open for cross-country travel.

Special Designations

Overall, motorized travel restrictions in special designations under Alternative C would result in the fewest adverse impacts to CTTM. Though the types of impacts would be similar to those described under Alternative A, Alternative C places the fewest restrictions on motorized travel to protect resources in areas with special designations. Alternative C designates only two ACECs, the Brown/Howe Dinosaur Area and Spanish Point Karst ACECs, and travel management in these areas does not vary across alternatives. Motorized vehicle use is limited to designated roads and trails in all WSAs in Alternative C, with impacts similar to those described under Alternative A.

Motorized vehicle use in areas in view within ¼ mile of the Nez Perce NHT and Other Historic Trails is limited to designated roads and trails, which would limit motorized vehicle use in areas proximate to these trails more than Alternative A, but less than Alternative B.

Resources

Under Alternative C, the emphasis of resource use over resource protection would result in decreased restrictions on motorized vehicle use compared to the other alternatives. As a result, Alternative C includes the most area open and limited to existing or designated roads and trails; which would benefit CTTM in the Planning Area by maximizing travel opportunities.

Stabilizing heavily eroded or washed out roads and trails, and allowing timber management spur roads to remain open to meet travel and other resource goals, would benefit CTTM by increasing the accessibility of BLM-administered land.

Management and restrictions in wildlife, special status species, and crucial habitat would result in less adverse impacts to CTTM compared to Alternative B. Travel management in the Absaroka Front Management Area would be less restrictive than Alternative B resulting in increased travel and access opportunities in this area.

Proactive Management

Beneficial impacts to CTTM under Alternative C would result from allowing the most open cross-country motorized vehicle use on 14,873 acres and allowing over-snow travel, unless precluded by other resource needs. Overall, Alternative C includes the fewest restrictions and the greatest amount of beneficial proactive management actions that allow opportunities for motorized and mechanized vehicle access to BLM-administered lands. Under Alternative C, the BLM would maintain any previously implemented site-specific travel management plans; impacts would be similar to those described under Alternative A. Allowing off-road motorized and/or mechanized vehicle use for big game retrieval and accessing dispersed campsites would result in impacts similar to those described under Alternative A. Overall, the motorized travel restrictions for the Planning Area under Alternative C would result in the least adverse impacts to CTTM compared to the other alternatives.

Alternative D

Resource Uses

Alternative D would result in the same amount of new roads from ROW authorizations as Alternative A and the second-most new roads in locales open to cross-country motorized travel or from BLM road and trail creation. Based on projected surface disturbance, Alternative D would result in 2,709 miles (3,941 acres) of new road and trail creation due to user-pioneered routes in areas open to cross-country motorized travel and new BLM-created routes (Appendix T).

Alternative D would benefit CTTM from new recreational road and trail development similar to Alternative B, but to a greater extent. Under Alternative D, the BLM would develop the same motorized touring loops, trails, and trailheads in SRMAs and RMZs as Alternative B. Alternative D opens 5,941 acres to off-road motorized vehicle use, the second most among the alternatives.

Impacts to CTTM from ROW management would be similar in type but greater in extent than those under alternatives A and C and less than under Alternative B. Under Alternative D, the BLM would manage the second-largest acreage as ROW avoidance/mitigation areas and exclusion areas.

Adverse impacts from restricting motorized vehicle use in recreation areas would be similar to those under Alternative B, but to a lesser extent. Under Alternative D, the BLM would place fewer restrictions on motorized vehicle use in the McCullough Peaks and Basin Gardens areas and the Beck Lake, Newton Lake Ridge, and Horse Pasture SRMAs than under Alternative B, but more than under alternatives A and C. Alternative D opens 4,468 acres to cross-country motorized vehicle use in the Basin Gardens Play Area SRMA, which would benefit CTTM.

Special Designations

The types of impacts to CTTM from the management of special designations would be similar to those described under Alternative A. Due to more motorized vehicle use restrictions to limit access, management of special designations under Alternative D would result in a greater adverse impact to CTTM than alternatives A and C, but less than Alternative B. Alternative D designates all nine ACECs designated under Alternative A with similar restrictions on motorized and mechanized vehicle use. Additionally, Alternative D designates the PETM, Clarks Fork Canyon, and Sheep Mountain ACECs and designates 52,485 acres of LWCs as Wild Lands, but there would be fewer restrictions on motorized and mechanized vehicle use in these areas than under Alternative B.

Restrictions on motorized vehicle use in WSAs would result in impacts to CTTM similar to Alternative A. Impacts to CTTM may be to a lesser extent because designated roads and trails in WSAs may include the routes inventoried during the initial WSA assessment, generally expanding access. However, impacts to CTTM may be to a greater degree because CTTM planning may designate only those routes inventoried during the initial WSA assessment, or even close those routes. Limiting motorized vehicle use to existing roads and trails in view within 5 miles of the Nez Perce (Neeme-poo) NHT would cause fewer adverse impacts to CTTM than would restrictions imposed around the NHT under alternatives B and C, but greater than those imposed under Alternative A.

Resources

In general, Alternative D emphasizes resource protection more than alternatives A and C, but less than Alternative B, resulting in proportional access restrictions and adverse impacts to CTTM. Adverse impacts from travel designations (e.g., seasonal restrictions) and mitigation measures to protect wildlife resources, special status species, and important habitats would be similar in type to Alternative A, although to a greater extent than under alternatives A and C and a lesser extent than under Alternative B. Restrictions on motorized vehicle use in the Absaroka Front Management Area would result in impacts similar to Alternative B. Allowing temporary closures of designated roads, trails, or geographic areas within big game crucial winter range and parturition habitat would result in impacts similar to Alternative B, although to a lesser extent. Limiting motorized vehicle use to designated roads and trails to protect resource values in essential and recovery habitat for threatened and endangered species and areas over important caves or cave passages would adversely affect CTTM by limiting access to these areas.

Closing timber haul roads after completion of timber management would result in impacts similar to Alternative A. Restricting off-road motorized vehicle use to within 300 feet of established roads in areas with a limited designation (existing or designated roads and trails) would result in impacts similar to Alternative B, although to a lesser extent.

Proactive Management

Beneficial impacts to CTTM under Alternative D would result from allowing the second most open cross-country motorized vehicle use on 5,941 acres and allowing over-snow travel on a case-by-case basis, and managing motorized vehicle use in most of the Planning Area (2,028,620 acres) as limited to existing roads and trails. Alternative D limits motorized vehicle use to designated roads and trails on 33 percent of BLM-administered land, 11 percent more than Alternative C, 34 more than Alternative A, and 49 percent less than Alternative B. Alternative D closes motorized vehicle use on a similar amount of acreage as Alternative A, but would result in greater adverse impacts to CTTM than alternatives A and C by limiting motorized vehicle use to designated roads and trails on more acreage than those alternatives.

4.6.5 Recreation

This section describes potential impacts to recreational uses of public lands under the alternatives in terms of direct, indirect, short-term, and long-term impacts.

Direct impacts to recreation affect the recreational resources, settings, experiences, and ultimately the desired beneficial outcomes from uses on public lands, including hunting, motorized travel (including OHV use), target shooting, wildlife viewing, camping, and other activities. Direct impacts also include impacts to recreational facilities such as campsites. Certain resource development or management actions (e.g., oil and gas development, fire and fuels management) will interfere with realizing desired beneficial outcomes, which will displace recreational users from their desired setting-specific areas, resulting in direct adverse impacts to recreation. Indirect impacts occur when competing uses of the land adversely affect natural recreational resources or recreational setting character conditions (RSCC) that no longer support desired experiences and beneficial outcomes. For example, impacts to wildlife habitats from competing land uses that result in a decrease in big game populations will therefore decrease the hunting (recreational) opportunities, and impact the experiences and beneficial outcomes.

Beneficial impacts to recreational resources include actions that improve the desired RSCC, increase recreational opportunities, contribute to better recreational experiences, and ultimately contribute to increase realized beneficial outcomes from recreational use of the public lands. Managing areas as SRMAs and ERMAs benefit recreation by managing for the desired RSCC, and marketing (niche matching) based on identified desired settings, activities, experiences, and benefits. Adverse impacts are those that degrade the desired RSCC, reduce the amount of recreation opportunity, and detract from the recreation experience, resulting in unrealized desired beneficial outcomes for recreational users.

4.6.5.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- The impact of RAMPs will be assessed following completion of the RMP revision.
- The SRMAs will be managed for the Niche, Management Objective, desired RSCC, experiences, and benefits, and Activity Planning Framework specified in the alternatives.

- Traditional recreational uses of Planning Area lands will continue, despite new recreational activities based on new technologies occurring in the area.
- The demand for fishing, floating, camping, OHV use, mountain biking, and new technology-based recreation is expected to increase. The number of hunters will fluctuate with the size of herds and other indirect factors, but because of less interest by younger generations, the number of hunters will decrease.
- The incidence of resource damage and conflicts between OHV users and nonmotorized recreationists will increase as OHV use increases.
- Visitation throughout the Planning Area will continue to increase as resource availability and conditions allow. As the population of both neighboring states and the local area continues to grow, the need or search for less crowded or more remote recreational opportunities will continue to bring more people to the public lands in Wyoming.

4.6.5.2 Summary of Impacts by Alternative

Management for surface disturbance, land tenure adjustments, areas closed or administratively unavailable for mineral development, special designations, proactive recreation management actions, and other resource management actions form the basis for comparing impacts to recreation among the alternatives. Proactive management under Alternative B would most enhance facilities and amenities to meet niche demands for recreation while minimizing potential user conflict, followed by alternatives D, A, and C. Alternative B would enhance the recreational experience of users expecting a more primitive recreational experience and opportunities for solitude the most, followed by alternatives D, A, and C. Dispersed motorized recreation opportunities would be limited to designated areas the most under Alternative B, which may result in the greatest adverse impacts to motorized recreation use compared to other alternatives, followed by alternatives D, A, and C. Alternative C would result in the most opportunities for dispersed motorized recreation, but primitive forms of recreation and opportunities for solitude would not be a priority and may diminish as OHV use increases over the planning cycle. Alternative D manages the second-most area for off-road motorized vehicle use, but also restricts motorized vehicle use to designated roads and trails in the second-most acreage that would limit recreation opportunities for motorized travel.

Special designations and management for resource protection in ACECs and WSRs that maintains their recreation settings for scenery and wildlife viewing would result in the greatest benefit to recreationists under Alternative B, followed by alternatives A, D, and C.

Alternative B would result in the least amount of surface disturbance, minerals development, ROW authorizations, and other conflicting resource uses that would displace recreation and potentially degrade the recreation setting, followed by alternatives D, A, and C. Alternative B would benefit recreational settings, experiences, and beneficial outcomes the most because the alternative manages the most areas as SRMAs for desired recreation settings to benefit outcome objectives, activities, experiences, and benefits, followed by alternatives D, A, and C. Alternative C manages the fewest areas as SRMAs, and would result in the greatest adverse impacts to the desired settings, opportunities, activities, experiences, and beneficial outcomes in areas with substantial recreation values, followed by alternatives D, A, and B. Although Alternative D manages less acreage in SRMAs than Alternative A, by managing these areas for the realization of benefits by maintaining the desired RSCC, SRMAs under Alternative D would result in more beneficial impacts to recreation experiences than under Alternative A.

4.6.5.3 Detailed Analysis of Alternatives

The NHTs and Other Historic Trails, National Back Country Byways, and CTTM sections describe impacts to these resource areas that are often used for recreation. This analysis focuses on impacts to recreational opportunities, experiences, and benefits for users, which often are associated with the recreation setting. Recreation management matrices in Appendix O identify the primary market strategy, niche, recreation management objective, desired RSCC, experiences, and beneficial outcomes, and implementation strategy/actions for each SRMA.

Impacts Common to All Alternatives

Surface Disturbance

Under all alternatives, activities that result in surface disturbance (e.g., facilities construction, clearing land, prescribed fires, and drilling activities related to minerals exploration and development) would result in adverse impacts by displacing recreationists from degrading the desired RSCC, opportunities, experiences, and desired beneficial outcomes for the life of the disturbance, or until the area is reclaimed or recovers. Surface disturbance would more intensively affect areas where the desired RSCC necessitates a high degree of naturalness (i.e., back country). Adverse impacts from surface disturbance would be less intensive in areas where the desired RSCC allows for moderately dominant alterations to the natural setting (i.e., middle country and front country). Development activities that improve legal access to public lands, establish new and improve existing roads, and increase opportunities for motorized travel may benefit recreational experiences. Refer to Appendix O for descriptions of the desired RSCCs throughout the Planning Area. Management actions limiting surface-disturbing activities in identified SRMAs would benefit recreational experiences by ensuring the maintenance of the recreational setting.

Resource Uses

Under all alternatives, minerals leasing and development would further alter supplemental values important for recreation such as scenic quality and natural, social, and administrative settings, and open previously limited areas to recreational use. The industrialized character associated with oil and gas activity would introduce new contrasting elements affecting the scenic quality of the recreation setting, interfering with recreationists' experiences and beneficial outcomes, which will displace recreationists from their desired settings to alternative areas. Travel off existing roads for "necessary tasks" associated with minerals management and other programs may generate new primitive routes for recreation opportunities, but the proliferation of roads and trails may threaten the recreation setting of certain areas and adversely affect such values as scenic quality, solitude, and wildlife. Hazards associated with road use would be proportional to the amount of mineral activity plus the historical recreational use. Minerals development would cause mostly adverse impacts to recreation under all of the alternatives.

Locatable mineral exploration and mineral materials disposal may result in adverse impacts to recreation. Mining activities may displace recreational activities and have an adverse impact on the desired recreation settings by altering the viewshed of some areas, and associated supplemental values such as wildlife and habitat, resulting in indirect impacts to recreation. Mining activities can also disrupt wildlife and alter habitat resulting in indirect impacts to recreation. Mitigation measures would minimize impacts to recreation resources from surface disturbance, but no mitigation would be applied to locatable mining activities to minimize adverse impacts to scenic qualities. The development of mineral resources may adversely affect recreation management due to hazardous conditions, noxious odors, and dangerous gas (such as H_2S) (see Section 4.8.3 *Health and Safety*).

Land tenure adjustments, including acquisition and disposal of land, generally benefit recreation if the adjustment considers recreational values. Acquisitions can result in beneficial impacts by improving public access in areas with intermingled land ownership and facilitating increased or improved access to recreation areas and resources such as WSAs and river access points. Private land that fragments BLM-administered land may interfere with recreationists' access, goals, activities, experiences, and benefits, and affect local and regional tourism. Acquiring and consolidating BLM-administered land and disposing of inholdings of private or state land would result in beneficial impacts to recreation, especially in SRMAs, WSAs, and other areas managed for specific recreation experiences. The acquisition of access easements can also increase recreational use across the Planning Area and would generally result in beneficial impacts to recreation.

Development activities associated with ROW authorizations would include renewable energy development, utility/transportation systems development, and communication site development. These developments, especially wind-energy facilities, may have a substantial impact on the recreation setting and recreationists' goals, experiences, and benefits by altering the scenic quality of open space and displacing users.

Under all alternatives, motorized and mechanized travel may enhance some recreationists' goals, experiences, and realize desired beneficial outcomes by allowing greater access to BLM-administered land while impairing others' by degrading the recreation setting and opportunities for solitude. Therefore, impacts from motorized and mechanized travel are likely to be site-specific. The BLM would address these impacts in more detail in assessing RAMPs.

Under all alternatives, the BLM would manage livestock grazing toward achieving the *Wyoming Standards for Healthy Rangelands*, which would minimize impacts to the recreation setting, experience, and opportunities. In many cases, promoting shorter duration of livestock use and manipulating the season of use would incorporate timing of recreation in order to reduce the impacts of livestock grazing on recreational experiences. The presence of livestock in a landscape setting is probably not detrimental to the experience of most recreationists; however, on a site-specific level, high levels of livestock use and facilities associated with grazing (e.g., water developments) may degrade recreationists' experiences due to noise, odor, and damage to vegetation. Such impacts would be more likely to occur around campgrounds, picnic areas, and trailheads. Off-road motorized vehicle use to support livestock management activities (e.g., round-ups) may affect the desired recreation settings by introducing new trails that may be used by other motorized travelers introducing new conflicting uses, as well as further augmenting the contrasting elements to the scenic characteristics, all of which would further interfere with recreationists' goals, experiences, and benefits.

Special Designations

Management actions in special designations under all alternatives would maintain legal public access and natural scenic qualities that will maintain the recreational setting characteristics and continue to provide for recreation opportunities and experiences. These actions include continuing the Red Gulch/Alkali Road National Back Country Byway designation and developing educational materials and facilities to enhance the knowledge of the Red Gulch/Alkali Road National Back Country Byway; closing BLM-administered lands in waterway corridors of WSR eligible and suitable segments to land disposal actions; closing WSAs to renewable energy development and mineral leasing; and various resource protection measures in the Spanish Point Karst ACEC. Resource protection measures also would preclude other forms of recreation, such as motorized travel. Impacts to special designations and the values for which they are designated are discussed in their respective sections of this chapter.

Resources

Management to protect soils and water quality and watershed management actions such as avoidance, mitigation, or application of BMPs (Appendix L) would protect water sources for campground facilities and would enhance recreation opportunities by providing potable water. Water and watershed management activities indirectly protect existing flow conditions and water quality that benefit activities and opportunities such as fishing and other river-related recreational activities, and maintains and enhances other related recreational resources.

Caves provide recreational opportunities but must also be protected for their unique and fragile biological and paleontological resources. Actions that restrict or limit access to caves for resource protection would result in adverse impacts to recreational use in these areas.

Short-term impacts to recreation from fire and fuels management would result in temporary closure of areas during and after fire events (including prescribed burns) and mechanized fuel treatments, which would displace recreationists. Long-term impacts from wildland fire may degrade the recreation setting and displace recreationists, but would also create new recreation opportunities and experiences.

Temporary recreation displacement would occur during commercial timber harvest activities because of a change in recreation settings, such as increased traffic, dust, noise, and loss of solitude. Logging operations that degrade the physical setting of naturalness may displace visitors. The intensity of the displacement would vary with the change in setting. Allowing harvests of minor wood products would provide recreation opportunities such as fuel wood gathering for campfires and may improve the recreation setting by improving forest health.

Vegetation management actions in riparian, wetland, and upland areas may displace recreationists from closed areas undergoing vegetation treatments (e.g., noxious weed control). In the long term, managing vegetation to meet the *Wyoming Standards for Healthy Rangelands* would, overall, maintain or improve the desired natural recreational resources and recreation setting conditions, thus improving desired opportunities, activities, experiences, and a realization of desired beneficial outcomes.

Fish and wildlife management decisions affect the habitat and health of fish and wildlife populations. Many recreation activities, such as hunting, wildlife viewing, bird watching, and fishing, would benefit from the presence of healthy and abundant wildlife habitats and populations. Spatial and temporal restrictions (e.g., CSU, TSL), and BMPs and mitigation to protect and improve habitat would benefit recreation under all alternatives, although the extent of these impacts varies by alternative. Management actions to protect or improve wildlife habitat that restrict certain activities, such as OHV use, may adversely affect some recreationists.

Wild horse management actions would protect, maintain, and control viable, healthy herds while retaining their free-roaming nature and providing opportunities for public viewing of wild horses. These actions would maintain a quality recreation setting and provide for unique supplemental values, opportunities, and experiences.

Management actions for cultural resources may require the relocation of potential recreation facilities in areas where the integrity of the setting contributes to NRHP eligibility. Areas containing significant cultural and paleontological resources may restrict certain recreational access or activities such as OHV use. However, developing cultural resource interpretive sites and making use of scenic overlooks, signs, and walking trails would increase recreation opportunities in these areas. Such actions may minimally impact recreation opportunities by moving facilities or rerouting access, displacing recreationists to other potentially less desirable areas.

Management of visual resources would maintain the overall integrity of the Planning Area's scenic qualities while allowing for development of existing and future uses. Limiting the visual impacts of management actions in VRM Class I and II areas would retain the recreation setting, whereas VRM Class III and IV areas would allow more modification of the natural environment that may detract from the recreation setting. Altering the recreation setting would influence recreational activities and may displace some recreationists seeking a back country recreation setting. Managing WSAs as VRM Class I areas under all alternatives would benefit recreationists seeking back country settings.

Proactive Management

Recreation management provides opportunities for outdoor recreation activities at both developed sites and dispersed areas. Under all alternatives, the BLM would manage recreation to provide for visitor health and safety, coordinate with other programs to minimize conflicts and adverse impacts to recreation opportunities, protect resources, maintain the desired RSCC, and enhance recreation by managing for realization of desired beneficial outcomes. Proactive management actions that would benefit recreation under all alternatives include continuing a withdrawal from appropriation under the mining laws in the Castle Gardens Scenic Area; maintaining an easement across private land for public access to Rainbow Canyon; retaining recreational access in the Bighorn River HMP/RAMP area; and mitigating surface-disturbing and disruptive activities associated with constructing, maintaining, and using roads, campgrounds, interpretive sites, and other recreation facilities, as described in Appendix H. Short-term benefits from proactive recreation management actions would preserve or increase visitor satisfaction by maintaining recreational settings, opportunities, and experiences. Long-term benefits would result from sustained recreation activity and realization of beneficial outcomes.

Managing areas as SRMAs would result in beneficial impacts to recreation in the Planning Area. In identifying SRMAs, the BLM manages the respective areas to provide specific "structured" recreation opportunities (i.e., identified settings, activities, experiences, and beneficial outcomes). SRMA management focuses on meeting outcome objectives developed in response to identified desired activities, experiences, and benefits. Recreation settings are prescribed to achieve the outcome objectives and guide allowable use decisions and management actions. In areas managed as ERMAs, recreation is not the predominant resource use, but recreation is recognized as one of the many uses on public lands. ERMA management actions are custodial in nature to address visitor health and safety, user conflicts, resource protection, and local planning issues. Management actions in ERMAs would result in a lower amount of recreational related focus such as niche-matching, marketing, and desired RSCC than the SRMAs. Table 4-15 summarizes ERMAs and SRMAs by alternative.

Table 4-15. Recreation Management Areas by Alternative

Area	Recreation Management Designation (acres)			
	Alternative A	**Alternative B**	**Alternative C**	**Alternative D**
Absaroka Foothills	SRMA (72,177)	SRMA (72,177)	ERMA	SRMA (52,422)
Bighorn River	SRMA (15,417)	SRMA (15,417)	ERMA	SRMA (2,545)
Badlands	SRMA (214,099)	SRMA (220,808)	ERMA	SRMA (220,808)
Tour de Badlands	-	RMZ (122,629)	-	RMZ (122,629)
Wild Badlands	-	RMZ (51,158)	-	RMZ (51,158)
Tatman Mountain	-	RMZ (47,022)	-	RMZ (47,022)
West Slope[1]	SRMA (373,755)	SRMA (126,914)	ERMA	SRMA (318,385)
Trapper Creek	-	RMZ (83,808)	-	-
Paint Rock	-	RMZ (45,079)	-	-
Canyons	-	-	-	RMZ (141,793)
Brokenback/Logging Road	-	RMZ (64,198)	-	RMZ (49,672)
South Bighorns	-	RMZ (84,333)	-	ERMA (69,551)/ SRMA (14,668)
Canyon Creek	-	SRMA (3,687)	-	SRMA (3,687)
Red Canyon Creek	ERMA	SRMA (8,435)	ERMA	Separate ERMA (8,435)
The Rivers	SRMA (18,278)	SRMA (18,278)	ERMA	SRMA (6,059)
Historic Trails	SRMA (12,083)	ERMA	ERMA	ERMA
Worland Caves	SRMA	Separate ERMA	ERMA	ERMA
McCullough Peaks	ERMA	SRMA (160,860)	ERMA	ERMA
Basin Gardens	ERMA	SRMA (19,847)	ERMA	ERMA
Basin Gardens Play Area	-	RMZ (1,857)	Separate ERMA	SRMA (4,468)
Basin Gardens	-	RMZ (17,985)	Separate ERMA	-
Horse Pasture	ERMA	SRMA (144)	ERMA	SRMA (144)
Rattlesnake Ridge	-	-	SRMA (7,996)	Separate ERMA (7,996)
Beck Lake	ERMA	SRMA (6,478)	ERMA	SRMA (6,475)
Newton Lake Ridge	ERMA	SRMA (2,295)	ERMA	SRMA (2,246)
Total Acreage SRMA/ERMA	**705,352/2,484,462**	**929,252/2,260,562**	**7,996/3,181,818**	**632,017/2,557,797**

Source: BLM 2009a

[1] For Alternative D, this area is broken up into the West Slope SRMA (126,920 acres) and the West Slope of the Bighorns SRMA (191,465 acres), which contains the Canyons and the Brokenback/Logging Road RMZs.

ERMA Extensive Recreation Management Area
RMZ Recreation Management Zone
SRMA Special Recreation Management Area

Alternative A

Surface Disturbance

Under Alternative A, a total of 136,415 acres of short-term and 15,710 acres of long-term surface disturbance is projected (Appendix T), most of which would result in adverse impacts to recreation. A portion of this disturbance would result from new facilities development (campsites, interpretive areas) and roads that may benefit recreation, but most would result in short- and long-term adverse impacts by displacing recreation and impairing the recreation setting for those seeking undisturbed landscapes. The intensity of impacts to recreation would depend on the location of surface disturbance in relation to the desired RSCC in the area being disturbed (see 'Impacts Common to All Alternatives'). Although Alternative A manages the second most acreage in SRMAs, it does not manage for the realization of desired outcomes and benefits to the same degree in these areas as alternatives B and D. Therefore, under Alternative A surface disturbance may limit the realization of benefits to recreationists more than alternatives B and D.

Resource Uses

Oil and gas development in areas of moderate potential (where most development is anticipated) is expected to add 1,130 new federal wells (Appendix T) resulting in 3,390 acres of short-term surface disturbance during the planning cycle (Appendix T). The additional oil and gas facilities, equipment, noise, dust, vehicles, night lighting, pipelines, and human activity would alter the recreation setting to an industrial setting in certain areas, which would interfere with recreationists' goals, and influence their opportunities, activities, experiences, and benefits. Under Alternative A, 3,124,724 acres of BLM-administered surface are available for locatable mineral entry and 10,000 acres of long-term surface disturbance are projected from locatable mining activities. Minerals development would result in adverse impacts by displacing recreation opportunities in areas with degraded scenic qualities. The potential increase in the visitor concentration in alternate recreation settings may detract from the quality of recreational experiences in those areas, especially for those seeking solitude.

Acquisitions and land tenure adjustments under Alternative A may increase recreation opportunities and enhance recreationists' experiences as described under Impacts Common to All Alternatives. Considering and pursuing acquisitions for public access in areas such as the Bighorn and Greybull rivers and in SRMAs would result in beneficial impacts to recreation by increasing recreation opportunities in these areas.

Pursuing withdrawals results in beneficial impacts to recreation by reducing surface-disturbing activities associated with mining, protecting the scenic quality, and maintaining the recreation setting. Alternative A withdrawals of 174,554 acres, including the Beck Lake Scenic Area, result in a direct beneficial impact by preserving the recreation setting of this area.

The BLM considers renewable energy development, including wind-energy development, on a case-by-case basis throughout the Planning Area under Alternative A. Due to the lack of management actions to facilitate its consolidation, wind-energy development may result in adverse impacts to recreation opportunities and scenic values important to the desired RSCC and associated opportunities, experiences, and benefits under Alternative A. The designation of ROW corridors would concentrate ROW authorizations and result in adverse impacts in and around these areas. However, concentrating ROWs in designated areas and avoiding or excluding ROW development in areas may result in beneficial impacts to recreation by prohibiting or limiting ROW infrastructure that can detract from the desired RSCC, opportunities, experiences, and benefits. Alternative A manages 941,778 acres as ROW avoidance/mitigation and 61,416 acres as ROW exclusion areas.

Alternative A places few restrictions on motorized vehicle use and most of the Planning Area is limited to existing roads and trails, which would result in beneficial impacts by facilitating access for recreation opportunities. Allowing OHV use for big game retrieval would result in beneficial impacts to hunting and recreation. Alternative A, however, opens the smallest area to off-road use, limiting recreation opportunities in this regard. In the 15-mile and Rattlesnake Ridge areas, where cross-country motorized travel is allowed or tolerated, recreationists would have off-road opportunities, though the use of these areas may result in adverse impacts to the cultural and recreational opportunities along some Other Historic Trails (see Chapter 3 *Comprehensive Travel and Transportation Management* for additional information). Allowing OHV use for big game retrieval, dispersed campsite access, and other "necessary tasks" may result in route proliferation and alterations to the scenic qualities of the landscape, which would affect the recreation setting and experience of those desiring solitude or primitive forms of recreation.

Closing Bighorn River tracts and campgrounds to livestock grazing, and managing livestock grazing for the protection and enhancement of other resource values, would maintain the recreation setting and minimize the potential for the displacement or impairment of recreation opportunities or experiences in these areas.

Special Designations

Special designations under Alternative A would affect the desired RSCC, opportunities, experiences, and realization of beneficial outcomes to recreationists in the Planning Area. Alternative A designates nine ACECs, seven of which have recreation values that include scenery, spelunking, hunting, and camping. Placing various restrictions on activities (e.g., mineral development, motorized vehicle use) that threaten the scenic values and natural setting in these areas would benefit these recreation values. Avoiding surface-disturbing activities and applying an NSO restriction within ¼ mile of the Nez Perce (Neeme-poo) NHT and Other Trails would preserve the recreation setting of these areas.

Managing WSR eligible waterway segments to protect their free-flowing characteristics and ORVs, including prohibiting water impoundments, limiting various mineral development activities, preventing an increase in grazing, and managing segments as VRM Class I or II would preserve the recreation setting and would maintain or enhance the primitive and recreational experiences and opportunities these segments provide. Under Alternative A, there are 12 WSR eligible waterways in the West Slope SRMA, and the Clarks Fork of the Yellowstone segment is in The Rivers SRMA. Prohibiting water impoundments, major diversions, or hydroelectric power facilities; pursuing a withdrawal from appropriation under the mining laws; applying NSO restrictions, and limiting geophysical exploration to foot access on various WSR eligible segments would provide beneficial impacts by helping to maintain the desired setting and experiences in these areas. However, closing segments to recreational dredging would adversely affect recreation management by eliminating recreational opportunities in these areas and opening the Middle Fork of the Powder River, Dry Medicine Lodge Creek, and Paint Rock Creek Unit segments to various mineral activity (e.g., leasing, geophysical exploration).

Allowing motorized vehicle use in WSAs may adversely affect recreationists seeking a natural setting and solitude, although recreationists seeking opportunities for motorized travel in remote areas would benefit. The lack of management prescriptions in LWCs under Alternative A also would threaten the natural setting and opportunities for recreationists seeking solitude in LWCs. Prior to impacting or impairing wilderness characteristics in LWCs, however, Alternative A requires project specific reviews that could help reduce the potential for adverse impacts to wilderness characteristics and associated recreational values.

Resources

Impacts from water quality, watershed, and soils management would be similar to those discussed in the Impacts Common to All Alternatives section, except for the action authorizing surface discharge of produced water from oil and gas development. The surface discharge of produced waters would change the physical hydrology of receiving waters and may affect water quality and create additional temporary water sources or evaporation/infiltration reservoirs that would require reclamation upon project completion. Changes in water quality in recreational fisheries may alter aquatic habitats, as described under Section 4.4.5 *Fish and Wildlife - Fish*, and cause adverse impacts to fishing and other recreation opportunities provided by functioning and healthy aquatic habitat. Under Alternative A, the BLM allows recreational use of Spirit Mountain cave and manages cave and karst resources under the Worland Caves SRMA to provide for recreation opportunities. Although not requiring a minimum group size in caves may increase safety risks for recreationists, management actions under this alternative would primarily benefit users of caves for recreation.

Wildland fire management actions would allow wildland fire to play its natural role and would be used for resource benefit when appropriate. Short-term localized impacts to recreation from fire and fuels management, including prescribed fire and mechanical fuels treatments, would result in temporary closure of areas during and after fire events and activities, which would displace recreationists to other areas. Prescribed fires may result in long-term impacts from the displacement of some recreationists because of the altered recreation setting, but would prevent larger catastrophic fires that would displace recreation for a longer time and create long-term safety hazards (e.g., tree fall) for recreationists. Stabilization and rehabilitation activities after a wildfire may prohibit recreational use in the short term while the area recovers, but would reduce the potential for future fires and result in long-term benefits to recreation.

Forest management would use a full range of methods in a manner that protects and benefits watershed, wildlife, and riparian/wetland habitat values to improve forest health. Timber harvesting activities (projected to affect 30,000 acres under Alternative A) would temporarily displace recreationists because of a change of recreation settings, such as increased traffic, dust, noise, and loss of solitude; these activities would also cause a loss of recreation opportunities during logging operations. Timber harvesting, when completed, would alter recreation settings, which would influence recreational opportunities and experiences. In the long term, closing timber access and haul roads, although eliminating potential motorized recreational use, would provide nonmotorized access into areas for other recreational opportunities, activities, and experiences.

Short-term impacts from vegetation treatments would temporarily displace recreationists from treated areas to other areas. The long-term impacts would be to enhance the recreation setting and recreational experiences by improving vegetation health and wildlife habitat.

Management actions under Alternative A that benefit fish and wildlife would benefit recreational activities such as fishing, hunting, bird watching, and general wildlife viewing. However, management actions that restrict public access to protect wildlife or its habitat from disturbance (e.g., restricting OHV use in areas with fragile soils) would limit access for motorized recreation opportunities. These management actions would interfere with some recreationists' goals and experiences, but would enhance the experiences and benefits for those pursuing nonmotorized related activities and experiences.

Impacts from management of cultural resources would be similar to those described under the Impacts Common to All Alternatives section.

VRM Class allocations for the Planning Area under Alternative A would result in beneficial impacts by preserving or retaining scenic qualities vital to the recreation setting in VRM Classes I and II (see Chapter 2). Requiring a VRM contrast rating worksheet in VRM Class I areas would help preserve the scenic characteristics of the landscape in these areas to be enjoyed by recreationists. However, limiting motorized vehicle use to designated roads and trails in VRM Class I and II areas would reduce access for those seeking recreational motorized travel in these areas. The BLM manages many areas popular for recreational activities and opportunities as Classes III and IV, which allows for noticeable and observable changes in the landscape. These changes, or unnatural contrasts introduced to the landscape, would impact the desired settings, which would interfere with recreationists' goals, experiences, and realized beneficial outcomes.

Proactive Management

Recreation Sites

Recreation management of developed sites would enhance recreation experiences and opportunities by prohibiting surface-disturbing activities (except those related to development of recreation facilities or wildlife habitat) and applying an NSO restriction in fishing and hunting access areas, the Five Springs Falls Campground, the Cody Archery Range, and R&PP lease areas for the Cody Shooting Complex and the Lovell Rod and Gun Club shooting range.

Recreation Management Areas (SRMAs, ERMAs)

Under Alternative A, the BLM manages eight areas as SRMAs (Table 4-15). The remainder of the Planning Area is in the Cody or Worland ERMA. The Impacts Common to All Alternatives section describes the benefits of designating SRMAs. The Recreation Management Area Matrix (Appendix O) provides a summary of management actions under each alternative in areas with specific recreation management designations. This section focuses on recreation management areas and proactive management actions under Alternative A that limit or prohibit resource uses and activities and result in beneficial impacts to recreation by maintaining or enhancing recreation settings, opportunities, experiences, and realization of beneficial outcomes.

Applying NSO restrictions on all or part of the Absaroka Foothills, Bighorn River, The Rivers, and Historic Trails SRMAs and the Canyon Creek Area would help maintain the recreational setting and experience in these areas by limiting surface access to oil and gas and other leasable minerals. Additionally, mitigation through activity-level planning on mineral leases in the following areas would minimize potential impacts to the recreation setting: the Badlands, Bighorn River, Absaroka Mountain Foothills, and West Slope SRMAs, and the Red Canyon Creek and Horse Pasture areas.

Closing the Bighorn River SRMA to surface-disturbing activities, such as geophysical exploration and salable mineral exploration, would maintain the recreation settings important for river related activities such as fishing, hunting, and boating.

Managing the Bighorn River, West Slope, and The Rivers SRMAs as ROW avoidance/mitigation areas would help prevent recreation displacement by preserving the desired RSCC, opportunities, experiences, and beneficial outcomes. All SRMAs are open to renewable energy development under Alternative A; however, limitations on ROW authorizations would apply to the development of renewable energy and may restrict development or require mitigation to minimize adverse impacts to recreation. Wind-energy development would result in adverse impacts to recreation by diminishing the recreation setting.

Although limiting motorized vehicle use to designated roads and trails would restrict opportunities for motorized recreational travel, recreationists seeking naturalness and more primitive forms of recreation

would benefit in the following areas: the Bighorn River (CYFO only), Absaroka Mountain Foothills, and West Slope SRMAs, and Red Canyon Creek areas; the North and South Forks of the Shoshone and the Clarks Fork of the Yellowstone rivers; and portions of the McCullough Peaks and Newton Lake Ridge areas. Motorized vehicle use is limited to existing roads and trails in other recreation areas, with off-road use tolerated in the Basin Gardens Play Area and Rattlesnake Ridge area to maximize recreation opportunities for activities such as motocross and hill climbing. Allowing unrestricted, motorized access to the Rattlesnake Ridge area poses a health and safety risk by exposing recreationists to high levels of H_2S gas in the area.

SRMAs are generally managed as VRM Classes IV, III, and II under Alternative A, retaining the existing character of the landscape to preserve the recreation setting, but allowing management activities and facilities development to respond to recreational needs. Managing areas such as the Red Canyon Creek area, areas in the West Slope, Absaroka Mountain Foothills, and Badlands SRMAs as VRM Class II would retain the scenic characteristics of this area, benefitting recreationists seeking a natural setting.

Alternative B

Surface Disturbance

Under Alternative B, a total of 73,919 acres of short-term and 10,882 acres of long-term surface disturbance is projected (Appendix T), most of which would result in adverse impacts to recreation. A portion of this disturbance would result from new facilities development and roads that may benefit recreation, but most would result in short- and long-term adverse impacts by displacing recreation and impairing the recreation setting for those seeking undisturbed landscapes. Alternative B would result in the least adverse impact to recreation from surface disturbance compared to the other alternatives. The intensity of impacts to recreation would depend on the location of surface disturbance in relation to the desired RSCC in the area being disturbed (see 'Impacts Common to All Alternatives'). Under Alternative B, the BLM would manage the largest acreage in SRMAs (Table 4-15) to maintain the desired RSCC, which would minimize the impacts of surface-disturbing activities where they would most adversely affect recreational experiences.

Resource Uses

Oil and gas development in areas of moderate potential (where most development is anticipated) is expected to add 509 new federal wells resulting in 1,527 acres of short-term surface disturbance during the planning cycle (Appendix T). Adverse impacts from oil and gas development under Alternative B would be similar to Alternative A, although to a lesser extent because Alternative B includes more restrictions on development. Under Alternative B, 2,918,444 acres of BLM-administered surface are available for locatable mineral entry (see Chapter 2) and the BLM projects 5,000 acres of long-term surface disturbance from mining activities. Adverse impacts from locatable mineral development would be similar to Alternative A, although to a lesser extent because Alternative B includes more mineral withdrawals (and less area open to mineral entry). Overall, management of minerals development under Alternative B would result in the least impacts to recreation compared to the other alternatives.

Acquisitions and land tenure adjustments under Alternative B would benefit recreation similar to Alternative A, although to a greater extent. Pursuing acquisitions for public access in the Bighorn and Greybull rivers and recreation management areas would result in beneficial impacts similar to Alternative A, although to a greater extent because Alternative B identifies more areas for acquisition for public access. Working collaboratively with landowners to pursue acquisitions under Alternative B also may increase the potential for adjustments that would increase recreational access and opportunities. The identification of land tenure adjustment zones would increase benefits associated

with acquisitions and disposals by identifying areas where adjustments would improve recreation opportunities and may expedite transactions to realize the benefits. Under Alternative B, pursuing a withdrawal in the Beck Lake Scenic Area would benefit recreation by maintaining the recreation setting and public access in the area.

Alternative B manages a total of 2,717,617 acres as ROW avoidance/mitigation and 225,750 acres as ROW exclusion areas, resulting in similar impacts to those under Alternative A, but to a greater extent due to the consolidation of ROWs that would preserve the RSCC more than Alternative A. Reducing and consolidating potential renewable energy development under Alternative B, especially wind-energy facilities, would result in the least potential for recreation displacement and visual impacts to recreation settings compared to the other alternatives.

Alternative B places the most restrictions on motorized vehicle use and limits most of the Planning Area to designated roads and trails. Restricting motorized vehicle use under this alternative would benefit recreation opportunities for solitude, natural settings, and primitive forms of travel more than under Alternative A. Alternative B, however, opens a larger area to off-road use than Alternative A, providing more recreation opportunities in this regard. Prohibiting OHV use for big game retrieval, dispersed campsite access, and other "necessary tasks" would benefit recreationists seeking solitude and primitive forms of recreation, but would adversely affect recreationists seeking more accessibility for certain activities (e.g., big game retrieval or dispersed campsites). Restricting over-snow vehicle use to areas with a minimum average of 12 inches of snow or groomed trails would limit recreation opportunities for snowmobilers and public access for other recreational uses, such as hunting.

Under Alternative B, the BLM would close crucial winter range for elk and bighorn sheep and greater sage-grouse Key Habitat Areas to livestock grazing. This action may indirectly benefit hunters and wildlife viewers by reducing livestock forage competition with game species and may reduce adverse impacts of livestock grazing management to greater sage-grouse (see Section 4.4.9 *Special Status Species - Wildlife* for more information about the interaction between livestock grazing and greater sage-grouse).

Special Designations

Under Alternative B, the BLM would manage special designations for the desired RSCC, opportunities, experiences, and realized beneficial outcomes for recreationists in the Planning Area. Alternative B designates 17 ACECs, 11 of which have recreation values that include scenery, nature viewing, spelunking, hunting, and camping. The benefits of these designations would be similar to Alternative A, but to a greater extent because Alternative B includes more special designations that cover a greater area. Designating all LWCs as Wild Lands and managing them to protect these characteristics where they overlap the Absaroka Mountain Foothills (11,189 acres), West Slope (18,812 acres), Bighorn River (3,216 acres), McCullough Peaks (50,129 acres), and The Rivers (6,542 acres) SRMAs and the Tatman Mountains RMZ (24,017 acres) may result in beneficial impacts to recreation experiences in areas managed for back country desired RSCCs.

Designating the Hyattville Logging Road and the Hazelton Road as Back Country Byways and managing these areas for responsible recreation would increase opportunities for recreation in the Planning Area; however, designation may increase the use of these routes enough to diminish solitude and recreation setting and experiences. Avoiding surface-disturbing activities in view within 5 miles and applying an NSO restriction within 3 miles of the Nez Perce (Neeme-poo) NHT and Other Historic Trails would preserve the recreation setting of these areas to a greater extent than management under Alternative A.

Under Alternative B, the West Slope SRMA contains six WSR suitable segments and The Rivers SRMA contains one. Desired outcomes in the West Slope SRMA include experiencing the landscape and developing a greater awareness of outdoor aesthetics in back country and middle country natural settings. Desired outcomes in The Rivers SRMA include developing a closer relationship with the natural world in areas with a rural natural setting, and enjoying risk-taking adventure and increasing local tourism revenue. In addition to the actions restricting minerals development under Alternative A, Alternative B closes WSR suitable segments to mineral leasing and geophysical exploration. This would provide additional benefits by protecting the desired RSCC in these areas. However, prohibiting surface-disturbing activities in all WSR suitable segments may adversely affect recreational experiences, especially in The Rivers SRMA, where facilities may need to be upgraded or expanded to accommodate more visitors.

Benefits from management actions in WSR suitable segments would be similar to Alternative A, although to a greater extent. Under Alternative B, all WSR eligible segments are recommended as suitable for inclusion in the NWSRS, closing these areas to activities (e.g., surface-disturbing activities, ROW authorizations) that would degrade their free-flowing characteristics and ORVs. Prohibiting surface-disturbing activities in WSR suitable segments would preclude recreation facilities development that may enhance the recreational experience in some areas. Under Alternative B, 14 of the 20 WSR suitable waterways would be closed to motorized vehicle use, preserving the natural setting and enhancing the experience for nonmotorized, primitive recreation in these areas.

Allowing maintenance on pre-FLPMA (grandfathered) range improvement projects may affect recreationists seeking a natural setting and solitude in WSAs. Closing all WSAs to motorized vehicle use under Alternative B, though eliminating motorized recreation opportunities, would provide the greatest opportunities for solitude and unconfined, primitive recreation. Acquiring inholdings and/or lands or interest in lands in WSAs would also enhance the recreation setting for solitude and unconfined, primitive recreation in these areas and increase access. The BLM designates all LWCs as Wild Lands and manages them to protect their wilderness characteristics. Because many LWCs are adjacent to WSAs, this management action would buffer the WSAs from activities that threaten the wilderness setting sought by recreationists in these areas.

Resources

Beneficial impacts from soils, water quality, and watershed management under Alternative B would be similar to those under Alternative A, although to a greater extent. Cooperating with local governments to develop watershed improvement practices that would reduce sediment in streams, rivers, lakes, and reservoirs and address impaired waterbodies on the state of Wyoming 303d list would preserve water quality for recreational uses of these resources. Prohibiting the discharge of produced water would eliminate the associated impacts described under Alternative A. Stabilizing or relocating heavily eroded or washed out roads would also benefit water quality for recreational uses and motorized recreation opportunities.

Under Alternative B, the BLM allows commercial recreational use of Spirit Mountain cave and manages cave and karst resources under a separate cave and karst ERMA that would emphasize resource protection, address user conflicts, public health and safety, and maintain the desired RSCC. Requiring a minimum group size in caves may decrease safety risks for recreationists, but would also limit recreation opportunities in caves. Recreation opportunities also would be restricted during critical times for bats and when the safety of users is at risk. Management actions under this alternative would provide less structured recreation prescriptions for caves than under Alternative A.

Fire and fuels management actions under Alternative B would result in impacts similar to Alternative A, although to a lesser extent because Alternative B includes less fuels treatments. Short-term impacts to recreation from disturbance associated with prescribed fire and treatments would be less than under Alternative A. Because Alternative B includes less fuels treatments, the risk of fuels buildup and larger catastrophic fires may be greater under this alternative. Fuels buildup and larger catastrophic fires may cause more long-term adverse impacts to recreation compared to Alternative A.

Impacts to recreation from forest management would be similar to Alternative A, although to a lesser extent. The BLM uses a full range of methods in a manner that protects and benefits watershed, wildlife, and riparian/wetland habitat values, but only harvests timber on approximately 20,000 acres during the planning cycle where natural processes are unable to accomplish forest health goals. Improved forest health would benefit the recreation settings and supplemental values, which in turn would influence overall recreation opportunities. As the forest declines in health, there may be adverse impacts to wildlife (e.g., big game) populations, resulting in adverse impacts to recreational experiences. Closing timber access and haul roads would result in the same impacts as Alternative A.

Impacts from vegetation treatments would be similar to Alternative A, although to a lesser extent because the BLM treats less acreage under Alternative B. In treated areas, managing toward 75 percent of Historical Climax Plant Community in grassland and shrubland communities and DPC in riparian/wetland areas may result in additional indirect benefits to recreationists by improving wildlife habitat to a greater extent than Alternative A.

Management actions under Alternative B that would benefit fish and wildlife would enhance recreational activities such as fishing, hunting, bird watching, and general wildlife viewing more than the other alternatives. However, these management actions also would restrict public access and limit opportunities for motorized recreational travel more than under the other alternatives.

Impacts to recreation from management of cultural resources would be similar to those noted under the Impacts Common to All Alternatives, although to a greater extent. For example, to minimize issues such as looting, limiting motorized vehicle use to designated roads and trails in the Bighorn Slope, Bridger, Owl Creek, and Absaroka Foothills areas would adversely affect opportunities for motorized recreation.

VRM Class allocations for the Planning Area under Alternative B would result in impacts similar to Alternative A, although to a greater extent. Pursuing conservation easements on lands adjacent to areas managed as VRM Classes I and II and requiring a contrast rating worksheet for proposed actions in areas managed as VRM Classes I, II, and III would result in additional benefits to recreation experiences by maintaining the recreation setting in these areas. Closing VRM Class I areas to motorized vehicle use would eliminate motorized recreation opportunities over a large area (154,343 acres) and cause adverse impacts to motorized recreational use.

Proactive Management

Recreation Sites

Recreation management of developed sites would result in impacts similar to Alternative A, although to a greater extent. More acreage would receive high priority recreation management under Alternative B than any other alternative, which may result in greater realized beneficial outcomes from specifically targeting the desired RSCC to enhance activities and experiences. In addition, management of popular recreation sites in the Bighorn Basin ERMA (e.g., Castle Gardens, Duck Swamp, and Nowater OHV Trail System) would result in beneficial outcomes, without the additional prescriptions from management as an SRMA, as ERMAs would receive the recreation management needed to address conflicts, health and safety, and resource protection.

Recreation Management Areas (SRMAs, ERMAs)

This section focuses on recreation management areas and proactive management actions under Alternative B that limit or prohibit resource uses and activities and result in beneficial impacts to recreation by maintaining or enhancing recreation settings, experiences, and opportunities. The Recreation Management Area Matrix (Appendix O) summarizes management actions under each alternative in areas with specific recreation management designations.

Under Alternative B, the BLM would manage 12 areas as SRMAs, including expansions of the Badlands and West Slope SRMAs (Table 4-15). The remainder of the Planning Area is in the Bighorn Basin ERMA. The Impacts Common to All Alternatives section describes the benefits of managing SRMAs. Within the 12 SRMAs, the BLM will manage nine RMZs for distinct recreational products strategically targeted to meet market demand and to manage for realized beneficial outcomes. RMZs may result in more benefits than solely SRMA designations by meeting specific niche demands, activities, opportunities, experiences, and benefits.

The BLM manages the Tour de Badlands RMZ in the Badlands SRMA, the Trapper Creek, Paint Rock, Brokenback/Logging Road, and South Bighorns RMZs in the West Slope SRMA, and the Red Canyon Creek and The Rivers SRMAs for motorized and nonmotorized recreation opportunities such as hiking, wildlife viewing, and fishing. The BLM emphasizes primitive, nonmotorized recreation opportunities in the Wild Badlands and Tatman Mountain RMZs in the Badlands SRMA, and the Canyon Creek, McCullough Peaks, Horse Pasture, Beck Lake, and Newton Lake Ridge SRMAs. Limiting motorized vehicle use to designated roads and trails in most of these areas would result in beneficial impacts to recreation experiences by reducing the potential for user conflicts. Closing the Beck Lake and Newton Lake Ridge SRMAs to motorized vehicle use would adversely affect opportunities for motorized recreation, but would benefit less intensive recreation opportunities such as mountain biking, hiking, and wildlife viewing. Unrestricted, off-road motorized recreation is consolidated in the Basin Gardens Play Area RMZ to maintain an undisturbed recreation setting and benefit recreation opportunities for primitive uses and solitude in other areas of the Planning Area. The Rattlesnake Ridge area is closed due to health and safety hazards associated with H_2S emissions from oil and gas development. This would interfere with motorized recreation and displace these users to other areas, potentially creating new conflicts.

Alternative B includes the most proactive management actions to retain the scenic landscape characteristics of areas with recreational value to maintain the desired RSCC. These actions include applying an NSO restriction in all SRMAs, closing all SRMAs to surface-disturbing activities, and managing all SRMAs as ROW avoidance/mitigation or exclusion areas.

In addition to placing the most restrictions on incompatible uses to preserve the recreation setting in SRMAs, the BLM also expands recreation facilities and amenities in SRMAs and RMZs the most under Alternative B to enhance the experience of primary recreation users. For example, adding designated trailheads and hiking trails in areas managed for nonmotorized uses (e.g., Canyon Creek SRMA), and vehicle touring loops in areas managed for motorized recreation opportunities as well (e.g., the Trapper Creek, Paint Rock, and Brokenback/Logging Road RMZs), would beneficially impact the recreational experiences in these areas while minimizing the potential for user conflict.

The BLM manages VRM Classes in SRMAs and RMZs consistent with their targeted benefits under Alternative B. All SRMAs and RMZs with substantial scenic values that are important to the recreational experience are managed as VRM Class II to retain the existing character of the landscape, while the Basin Gardens Play Area, where the recreational experience requires opportunities for off-road motorized recreation that partially alter the existing landscape, is managed as VRM Class III.

Although managing recreation more proactively under Alternative B to strategically targeted demands would enhance recreation opportunities and experiences in most areas, restricting recreation opportunities (especially dispersed motorized recreation) in some areas may result in localized adverse impacts to recreationists.

Alternative C

Surface Disturbance

Under Alternative C, a total of 245,783 acres of short-term and 41,545 acres of long-term surface disturbance is projected (Appendix T), most of which would result in adverse impacts to recreation. A portion of this disturbance would result from new facilities development and roads that may benefit recreation, but most would result in short- and long-term adverse impacts by impairing the recreation setting, which would displace those seeking undisturbed landscapes to more suitable areas. Alternative C would result in the greatest adverse impact to recreation from surface disturbance compared to the other alternatives. The intensity of impacts to recreation would depend on the location of surface disturbance in relation to the desired RSCC in the area being disturbed (see 'Impacts Common to All Alternatives'). Although the custodial management actions in ERMAs would result in limited benefits to recreational experiences, Alternative C manages the least acreage as SRMAs and pursues the least marketing and maintenance of the desired RSCC. Therefore, surface disturbance may affect benefits to recreationists the most under this alternative.

Resource Uses

Oil and gas development in areas of moderate potential (where most development is anticipated) is expected to add 1,257 new federal wells resulting in 3,771 acres of short-term surface disturbance during the planning cycle (Appendix T). Adverse impacts to recreation from oil and gas development under Alternative C would be similar to Alternative A, although to a greater extent because Alternative C includes more projected development. Under Alternative C, 3,165,898 acres of BLM-administered surface are available for locatable mineral entry (see Chapter 2) and 10,000 acres of long-term surface disturbance are projected from mining activities. Adverse impacts from locatable mineral development would be similar to Alternative A, although to a greater extent because Alternative C opens more area to locatable mineral entry and pursues withdrawals in the least amount of area. Overall, minerals development under Alternative C would result in the greatest adverse impacts to recreation compared to the other alternatives.

Acquisitions and land tenure adjustments under Alternative C would result in impacts similar to Alternative A, although to a lesser extent. Alternative C identifies less area for acquisition and more area for disposal than Alternative A. In addition, under Alternative C, the BLM would use acquisition in recreation areas primarily to address use and user conflicts and not to meet management objectives and desired recreation settings and opportunities in these areas. Under Alternative C, the BLM would not actively pursue acquisitions for public access to enhance recreational opportunities in the Bighorn River. This would place recreational access to the river as a low priority, which would affect both recreational opportunities and experiences, and the benefits of recreation to local tourism. The identification of land tenure adjustment zones would result in beneficial impacts similar to Alternative B.

Under Alternative C, the BLM would not pursue a withdrawal from appropriation under the mining laws in the Beck Lake Scenic Area, which may cause adverse impacts to recreation by allowing mining activities that potentially displace recreationists or diminish their experiences in this area.

Under Alternative C, the BLM would manage a total of 1,174,335 acres as ROW avoidance/mitigation areas and 7,762 acres as ROW exclusion areas, resulting in similar impacts to those under Alternative A, but to a greater extent due to more area managed as avoidance/mitigation or exclusion. Alternative C opens a total of 1,425,335 acres to renewable energy development. Alternative C may consolidate renewable energy development, such as wind-energy facilities, more than Alternative A, but not as much as Alternative B, resulting in correlated impacts from displacing recreationists and from visual impacts that may impair recreationists' experiences.

Alternative C places similar restrictions on motorized vehicle use as Alternative A, but more area is limited to designated roads and trails and open to off-road use. Limiting motorized recreation to designated roads and trails in more area would result in a lower potential for user conflict between motorized and primitive recreationists. However, allowing motorized vehicle use across the largest area and closing the least area under this alternative would cause greater adverse impacts to recreation opportunities for solitude, natural settings, and primitive forms of travel than the other alternatives. The greater accessibility for motorized vehicle use under Alternative C may adversely affect adjacent private lands by increasing the potential for recreationists to trespass. New route development from off-road use also would cause the greatest potential for altering the recreation setting for users seeking undisturbed landscapes. As under Alternative A, allowing cross-country motorized use in the 15-mile and Rattlesnake Ridge areas would provide opportunities for recreationists interested in riding off-road, but may result in adverse impacts to the cultural and recreational opportunities along some Other Historic Trails (see Chapter 3 *Comprehensive Travel and Transportation Management* for additional information). Allowing OHV use for big game retrieval, dispersed campsite access, and other "necessary tasks" would result in impacts similar to Alternative A.

Livestock grazing management under Alternative C would result in impacts similar to Alternative A. However, the BLM does not manage livestock grazing to protect and enhance other resource values, which may result in greater potential adverse impacts to recreational experiences where grazing practices conflict with recreational values, such as opportunities for solitude or back country settings.

Special Designations

Special designations under Alternative C would affect the opportunities, experiences, and settings available to recreationists less than the other alternatives. Alternative C designates no additional ACECs to those designated under all alternatives. Therefore, only the Spanish Point Karst and Brown/Howe Dinosaur Area ACECs would result in beneficial impacts by providing recreation opportunities for rock climbing, caving, and hiking and maintaining the scenic qualities of the area. No additional back country byways would be designated under this alternative to benefit recreation. Surface disturbance and NSO restrictions around the Nez Perce (Neeme-poo) NHT and Other Historic Trails would result in similar beneficial impacts to those described under Alternative A. However, more utility corridors may affect the recreational setting of the trails under this Alternative.

Under Alternative C, the BLM would not apply any special management actions to WSR eligible waterway segments. Allowing other uses in these areas (e.g., oil and gas leasing, geophysical exploration) would result in the greatest potential adverse impact to recreational opportunities, settings, and experiences in these areas compared to the other alternatives. Back country and more primitive forms of recreational opportunities available in these waterway segments, such as hunting, fishing, camping, hiking, and sightseeing, would be adversely impacted, which would result in non-realization of beneficial outcomes. Such impacts may also result in adverse impacts to local tourism and its associated benefits.

Impacts from WSAs would be similar to those under Alternative A. However, the BLM limits motorized vehicle use to designated roads and trails in the Honeycombs and Cedar Mountain WSAs under Alternative C, which may result in fewer opportunities for motorized recreationists but would enhance the experience for those seeking solitude and primitive recreation. The converse would be true in the remainder of the WSAs, where Alternative C allows motorized vehicle use to a greater extent than Alternative A. Potential impacts to recreationists from the lack of management prescriptions in LWCs would be similar to those under Alternative A.

Resources

Beneficial impacts from soils, water quality, and watershed management under Alternative C would be similar to those under Alternative A, although to a lesser extent because Alternative C includes fewer restrictions. Addressing impaired waterbodies on the state of Wyoming 303d list may enhance water quality for both recreational resources and recreational uses of these resources, but a lack of watershed improvement practices would result in the greatest potential for sedimentation in waterbodies that have recreational values. Allowing the discharge of produced water would result in impacts similar to Alternative A. Stabilizing heavily eroded or washed out roads would benefit water quality for recreational uses.

Impacts to recreational users of cave and karst resources under Alternative C would be similar to those under Alternative B. Under Alternative C, the BLM encourages commercial caving tours of Spirit Mountain cave, which would enhance opportunities for tourists but may diminish experiences or reduce opportunities for local recreationists. Encouraging tourism may also affect cave and karst resources by exceeding the Limits of Acceptable Change and Carry Capacity. These impacts can degrade physical characteristics, which may result in adverse impacts to recreational experiences and benefits.

Fire and fuels management under Alternative C would result in impacts similar to Alternative A, although to a greater extent because Alternative C includes more prescribed fire and mechanical fuels treatments. Short-term localized impacts to recreation from prescribed fire and fuels treatments would be greatest under Alternative C. Due to increased fuels treatments under Alternative C, the risk of fuels buildup and larger catastrophic fires may decrease under this alternative. Decreased fuels buildup and larger catastrophic fires may result in greater long-term benefits to recreation compared to the other alternatives.

Impacts to recreation from forest management would be similar to Alternative A, although to a greater extent. The BLM uses a full range of timber harvesting methods to maximize forest products. Timber harvesting on approximately 40,000 acres during the planning cycle would have the greatest potential to displace recreation or adversely affect the recreation setting in the long term. However, using a full range of silviculture techniques to manage insect and disease may help prevent the spread of infestations and preserve the recreation setting. Allowing timber access and haul roads to remain open for new recreational purposes would result in increased accessibility and new recreation opportunities, but also may impact the recreation setting in remote areas by altering scenic characteristics or the recreation experience for those seeking solitude.

Impacts from vegetation treatments under Alternative C would be similar to those under Alternative A, although to a greater extent because the BLM treats more acreage under Alternative C. Not managing habitat such as crucial winter range to meet DPC objectives most beneficial for the identified species may result in fewer indirect benefits to recreationists through improving vegetative health for wildlife habitat.

Management actions under Alternative C that would benefit fish and wildlife would enhance recreational activities such as fishing, hunting, bird watching, and general wildlife viewing; however,

benefits impacts would be the least under Alternative C compared to the other alternatives. These management actions would permit public access and create opportunities for motorized recreational travel the most compared to the other alternatives. Semi-primitive settings would be affected by this management, and recreationists desiring those settings would not achieve a realization of beneficial outcomes and may seek those benefits in other areas.

Impacts from cultural resources management under Alternative C would be similar to Alternative B.

VRM Class allocations for the Planning Area under Alternative C would result in impacts similar to those under Alternative A, although to a lesser extent. Exempting all mineral actions and activities in designated ROW corridors from contrast rating worksheets would make these developments more visible from surrounding areas, increasing adverse impacts to the setting for recreationists seeking natural landscapes. Under Alternative C, the BLM does not limit motorized vehicle use by VRM Class, increasing opportunities for motorized recreation in scenic areas, but also increasing the potential for new trail and route development to alter the recreation setting for more primitive forms of recreation.

Proactive Management

Recreation Sites

Alternative C would involve the least proactive management to maintain or enhance the desired RSCC, enhance recreationists' opportunities and experiences, and to realize beneficial outcomes. Allowing surface-disturbing activities (e.g., geophysical exploration and salable minerals development) in fishing and hunting access areas; the Five Springs Falls Campground; the Cody Archery Range; and R&PP lease areas for the Cody Shooting Complex and the Lovell Rod and Gun Club shooting range may displace recreation and adversely affect the recreation setting. This would be most notable in the Five Springs Falls Campground and other areas where recreationists may seek a generally undisturbed setting.

Recreation Management Areas (SRMAs, ERMAs)

Under Alternative C, the BLM manages only the Rattlesnake Ridge SRMA, and manages the remainder of the Planning Area under the Bighorn Basin ERMA or as separate ERMAs (Table 4-15). Management actions in ERMAs are less proactive to enhance recreation opportunities or experiences, and are primarily custodial in nature. By designating only one SRMA, Alternative C would result in the fewest proactive measures to manage for desired RSCC, opportunities, activities, experiences, and desired beneficial outcomes.

Alternative C also places the fewest restrictions on resource uses and surface-disturbing activities to maintain the recreation settings in areas managed as SRMAs under Alternative B (Appendix O). In most areas with recreational use, scenic values are important to recreationists' experiences. Allowing activities such as mineral development and ROW authorizations (i.e., wind-energy development) in these areas would result in the highest potential for degradation of generally undisturbed areas that benefit recreationists' experiences in popular areas such as the Absaroka Foothills, Badlands, West Slope, Red Canyon Creek, and the Bighorn River.

Allowing more development and motorized vehicle use (permitted on existing roads and trails in all recreation areas except the Trapper Creek area in the Spanish Point Karst ACEC under Alternative C) would diminish the desired settings and those setting-dependent resources and opportunities for solitude in several places. Areas such as the Tour de Badlands (as delineated in Alternative B) produce recreation opportunities for motorized travel and sight-seeing, and for solitude in natural landscapes, which would be threatened by unrestricted motorized vehicle use in remote areas. Other areas where expanded motorized vehicle use would threaten opportunities for solitude include the Absaroka

Foothills, West Slope of the Bighorns, Canyon Creek, and McCullough Peaks areas. Because the BLM expects OHV use to increase throughout the Planning Area, opportunities for primitive forms of recreation and solitude would decrease unless the BLM limited or closed motorized vehicle use in certain areas.

Under Alternative C, the BLM manages most recreation areas as VRM Classes III and IV, allowing for the greatest alteration of the natural landscape in these areas. For example, this alternative manages the Red Canyon Creek area as VRM Class IV, which would result in the fewest measures to protect the scenic qualities that contribute to the recreation setting of this area.

Designating and expanding the Rattlesnake Ridge SRMA for the allowance of off-road motorized vehicle use, despite potential health and safety risks, would enhance opportunities for motorized recreation and meet the niche demand for activities such as all-terrain vehicle and motorbike use.

Alternative D

Surface Disturbance

Under Alternative D, a total of 140,508 acres of short-term and 28,079 acres of long-term surface disturbance is projected (Appendix T), most of which would result in adverse impacts to recreation. Impacts would be similar in type and extent to those under Alternative A. The intensity of impacts to recreation would depend on the location of surface disturbance in relation to the desired RSCC in the area being disturbed (see 'Impacts Common to All Alternatives'). Alternative D manages less acreage in SRMAs than Alternative A, but specifically identifies desired outcomes and RSCCs in SRMAs—and applies certain restrictions to better maintain them, which may limit adverse impacts from surface disturbance to recreation management more than Alternative A.

Resource Uses

Oil and gas development in areas of moderate potential (where the most development is anticipated) is expected to add 1,032 new federal wells resulting in 3,096 acres of short-term surface disturbance during the planning cycle (Appendix T). Adverse impacts from oil and gas development under Alternative D would be similar to Alternative A, although to a lesser extent. Adverse impacts from locatable mineral development would be similar to Alternative A, although may affect a larger area because Alternative D makes more acreage available for locatable mineral entry.

Acquisition and land tenure adjustments under Alternative D would result in impacts similar to Alternative C, although to a greater extent. Alternative D identifies less land for disposal and more land for acquisition than alternatives A and C. The identification of land tenure adjustment zones would result in benefits similar to Alternative B. Under Alternative D, the BLM pursues acquisitions for public access to enhance recreational opportunities in the Bighorn River more actively than under Alternative C, but less so than under alternatives A and B. Pursuing a withdrawal from appropriation under the mining laws in the Beck Lake Scenic Area would result in the same benefits as Alternative A.

Renewable energy development and ROW development would result in impacts similar to, but to a greater extent than alternatives A and C (and a lesser extent than Alternative B). Under Alternative D, the total area managed as ROW exclusion or avoidance/mitigation is larger than under alternatives A and C, which is likely to result in a greater consolidation of ROWs with proportional benefits to the RSCC and recreational opportunities and experiences.

Travel and transportation management under Alternative D would result in impacts similar to those under Alternative A; however, Alternative D places more restrictions on motorized vehicle use, which would result in greater benefits to recreation opportunities for solitude, natural settings, and primitive

forms of travel. Alternative D manages the second most acreage as open to cross-country motorized travel, augmenting recreation opportunities in this regard more than alternatives A and B, but less than Alternative C. Restricting off-road motorized vehicle use in areas with limited travel designations to within 300 feet of roads and trails would result in impacts similar to Alternative B, although to a lesser extent.

Livestock grazing management under Alternative D would result in impacts similar to Alternative A.

Special Designations

The ACECs designated under Alternative D would result in impacts similar to Alternative A, although to a greater extent because Alternative D designates three additional ACECs with recreational values. Alternative D also restricts certain resource uses and activities (e.g., minerals development) in the Chapman Bench Management Area to protect sensitive wildlife habitat that may benefit recreational wildlife viewing opportunities, especially bird watching.

Back country byway designations under Alternative D would result in benefits similar to Alternative B, although to a lesser extent because the BLM would not designate the Hazelton Road but would consider designating new back country byways on a case-by-case basis in cooperation with stakeholders. The BLM applies measures to protect the scenic qualities of the Nez Perce (Neeme-poo) NHT and Other Historic Trails in a more discretionary manner under Alternative D than under the other alternatives. The BLM may protect the viewshed in a larger area around the trails than under alternatives A and C, but with the use of mitigation measures and BMPs, may allow more activities that may affect the scenic quality of the trails (e.g., a CSU restriction versus an NSO restriction).

The BLM does not apply any special management actions to WSR eligible segments under Alternative D, and impacts would be similar to Alternative C.

The potential beneficial impacts to recreationists from designating some LWCs as Wild Lands (52,485 acres) under Alternative D would be similar to those described under Alternative B, but to a lesser extent.

Resources

Beneficial impacts from soils, water quality, and watershed management under Alternative D would be similar to Alternative A, although to a greater extent than alternatives A and C and a lesser extent than Alternative B. Developing watershed improvement practices; cooperating with adjacent landowners, managers, and the Wyoming DEQ to address waterbodies that do not meet state water quality standards; and giving priority to stabilizing or relocating heavily eroded or washed out roads would result in benefits similar to Alternative B.

Allowing for commercial tours of Spirit Mountain cave would result in impacts similar to Alternative C. Impacts to recreation opportunities in caves from requiring minimum group sizes and closing caves for critical bat periods and to protect user safety would be similar to Alternative B.

Based on the extent of treatment estimated from the acreage of projected surface disturbance from prescribed fire and mechanical fuels treatments (Appendix T), fire and fuels management under Alternative D would result in impacts similar to Alternative A.

Forest, woodlands, and forest products management under Alternative D would result in similar impacts as Alternative A, except that using the full range of silviculture techniques to manage endemic insect and disease would result in the same benefits as Alternative C.

Based on the acreage of projected surface disturbance (Appendix T), vegetation treatments would result in similar impacts as Alternative A. Managing grassland and shrubland communities toward achieving 65 percent of Historical Climax Plant Community would result in indirect benefits similar to Alternative B.

Management actions under Alternative D would benefit fish and wildlife, and therefore enhance recreational activities such as fishing, hunting, bird watching, and general wildlife viewing, more than alternatives A and C but less than Alternative B. Correspondingly, management actions to protect wildlife habitat would restrict public access and limit opportunities for motorized travel more than alternatives A and C, but less than Alternative B.

Impacts from management of cultural resources would be similar to those described under Impacts Common to All Alternatives.

VRM Class allocations under Alternative D would result in impacts to recreation similar to Alternative A, although to a greater extent because Alternative D allocates more acreage in VRM Classes I and II. Not limiting motorized vehicle use by VRM Class would result in similar impacts as Alternative C.

Proactive Management

Recreation Sites

Under Alternative D, the BLM would pursue a greater degree of proactive management to maintain or enhance the desired RSCC in recreation sites than alternatives A and C, but less than Alternative B. Alternative D applies the same NSO restrictions in recreation sites as Alternative B, but allows surface-disturbing activities, similarly to Alternative C, in recreational sites and trails on a case-by-case basis.

Recreation Management Areas (SRMAs, ERMAs)

This section focuses on recreation management areas and proactive management actions under Alternative D that limit or prohibit resource uses and activities and would result in benefits to recreation by maintaining or enhancing recreation settings, experiences, and opportunities. The Recreation Management Area Matrix (Appendix O) summarizes management actions under each alternative in areas with specific recreation management designations.

Under Alternative D, the BLM would manage 12 areas as SRMAs, but the Absaroka Foothills, Bighorn River, West Slope, and The Rivers SRMAs are substantially smaller than under Alternative A; the Badlands SRMA increases by approximately 7,000 acres. The Impacts Common to All Alternatives section describes the benefits of managing SRMAs. In addition to the Bighorn Basin ERMA, Alternative D identifies five separate ERMAs. The Impacts Common to All Alternatives section describes Impacts from managing ERMAs. Within the 12 SRMAs, the BLM manages five RMZs; see Alternative B for a description of the beneficial impacts of RMZs.

The BLM manages Tour de Badlands RMZ in the Badlands SRMA, the Canyons and Brokenback/Logging Road RMZs in the West Slope SRMA, and the Middle Fork of the Powder River, The Rivers, Beck Lake, and Newton Lake Ridge SRMAs for motorized and nonmotorized recreation opportunities such as hiking, wildlife viewing, and fishing. The BLM emphasizes primitive, nonmotorized recreation opportunities in the Wild Badlands and Tatman Mountain RMZs in the Badlands SRMA, and the Absaroka Foothills, Canyon Creek and Horse Pasture SRMAs. Limiting motorized vehicle use to designated roads and trails in these areas, except for the Horse Pasture SRMA and the Wild Badlands RMZ, would result in beneficial impacts to recreation experiences by reducing the potential for user conflicts. Limiting motorized vehicle use to designated roads and trails in the Horse Pasture SRMA would increase the potential for user conflicts and may adversely affect recreation experiences in the area. This impact

would be minimal due to the low amount of roads within the area. Designating roads and trails will aid in maintaining the desired settings, activities, and experiences by enhancing the naturalness of the area. Limiting motorized vehicle use in the Beck Lake and Newton Lake Ridge SRMAs would result in impacts similar to Alternative B, although to a lesser extent. Managing the Basin Gardens Play Area SRMA for motorized recreation opportunities would result in impacts similar to Alternative B, but increasing its size under Alternative D would benefit recreation to a greater extent by responding more appropriately to the increasing demand for motorized recreation opportunities. Managing the Rattlesnake Ridge area as a separate ERMA would maintain the current recreational opportunities resulting in benefits similar to Alternative C, although to a lesser extent because the area is not managed as open to cross-country motorized travel, nor will the area be marketed as an OVH area. Management prescriptions specific to this separate ERMA will address the safety concerns (primarily the H_2S hazard) and conflicts due to the oil and gas activities and the motorized recreational activities. Actively addressing these issues will maintain and enhance the desired experiences and beneficial outcomes.

Alternative D includes the second most proactive management actions to retain the scenic landscape characteristics of areas with recreational value to maintain the desired RSCC. Within SRMAs, these actions include applying a CSU stipulation, allowing surface-disturbing activities only if the effects can be avoided or mitigated based on site-specific analysis, and managing most SRMAs as ROW avoidance/mitigation areas.

However, maintaining the desired RSCC in Alternative D will not be as effective as Alternative B. Managing the SRMAs without an NSO stipulation will allow surface-disturbing activities that may not effectively be mitigated, which will compromise the desired settings. Impacts to the settings within the SRMAs will adversely impact the goals and experiences desired by those visiting the area. These areas are managed for community, destination, and undeveloped strategies, which commits the BLM to effectively manage these areas to meet the identified expectations (settings, experiences, and benefits) of the community, and those who travel from outside the region to enjoy the SRMAs. Settings compromised by surface-disturbing activities will interfere with visitors' goals and experiences, which will displace visitors to alternative areas. This goal interference and displacement will adversely impact local tourism and will not meet the objectives of the SRMAs.

The beneficial impacts from expanding SRMAs and separate ERMAs would be similar to those under Alternative B, although to a lesser extent because Alternative D manages less acreage of BLM-administered public lands as SRMAs.

VRM Class allocations under Alternative D would result in benefits to the recreation setting similar to Alternative B in the Absaroka Mountain Foothills, Bighorn River, Canyon Creek, and Newton Lake Ridge SRMAs and the Canyons and Brokenback/Logging Road RMZs. Managing the West Slope and The Rivers SRMAs as VRM Classes II and III would result in a greater beneficial impact by preserving the desired RSCC in these areas than under alternatives A and C, but less than under Alternative B. Allocating VRM classes consistent with other resource objectives in the Tour de Badlands and Tatman Mountain RMZs, the Horse Pasture and Beck Lake SRMAs, the South Bighorns and Red Canyon Creek ERMAs, and McCullough Peaks area may cause adverse impacts to the recreation setting. This would be especially true in areas where the desired RSCC depends more on a back country setting, such as the Tatman Mountain RMZ and the Red Canyon Creek and South Bighorns ERMAs.

4.6.6 Lands with Wilderness Characteristics

The BLM inventory identified approximately 571,288 acres (in 51 LWCs) of BLM-administered land with wilderness characteristics in the Planning Area, or approximately 18 percent of total BLM-administered

land in the Planning Area. Chapter 3 describes the process used to inventory LWCs and lists the current key management for each of these areas.

This section presents an analysis of proposed management actions for LWCs that are likely to result in impacts to other resources, resource uses, and special designations. This section also analyzes the effects of management actions on the wilderness characteristics identified in these areas.

Adverse impacts from management in LWCs result from actions that restrict resource uses or the management of resources, while beneficial impacts are those that enhance other resource uses or the management of resources. Adverse impacts to LWCs occur when natural conditions, opportunities for solitude, or opportunities for primitive, unconfined recreation (collectively known as wilderness characteristics) are compromised. Beneficial impacts occur when the above conditions are preserved or improved. Direct impacts would result from management actions that affect other resource uses or activities in LWCs. Indirect impacts to other resources (e.g., soils and vegetation) may result if management actions in LWCs displace resource uses or activities (e.g., minerals development) to areas outside of these lands, thereby augmenting impacts in other areas.

For a discussion of wilderness characteristics in WSAs, please refer to Section 4.7.6 *Wilderness Study Areas*.

4.6.6.1 Methods and Assumptions

LWCs in the Planning Area are not subject to the *Interim Management Policy and Guideline for Lands under Wilderness Review: Update Document H-8550* or other policies or guidance applicable to WSAs or Wilderness Areas.

Under Alternative A, decisions on projects in LWCs would be consistent with current management.

4.6.6.2 Summary of Impacts by Alternative

Under alternatives A and C, no LWCs are designated as Wild Lands. Therefore, the preservation of wilderness characteristics (e.g., a high degree of naturalness, outstanding opportunities for solitude, or outstanding opportunities for primitive and unconfined recreation) in LWCs would be least effective under these alternatives. In contrast, LWCs under Alternative B (571,288 acres) are designated as Wild Lands, and are specifically managed to protect naturalness, outstanding opportunities for solitude, and primitive and unconfined recreation. Although many LWCs in the Planning Area contain potential resource conflicts that may be inconsistent with retention of wilderness characteristics (see Table 3-46), under Alternative B the BLM will apply management to preserve these characteristics to the extent practicable. Such management would be a beneficial impact for wilderness characteristics. Alternative D designates 52,485 acres as Wild Lands. Alternative D designates nine LWCs as Wild Lands in areas consistent with similar resource protections. This alternative would not designate the remaining LWCs as Wild Lands, based on resource conflicts identified in Chapter 3 (Table 3-46).

Alternatives A and C include the least restrictive management of resource uses that involve surface disturbance or degrade the natural character of the landscape in LWCs. Alternative C would result in the greatest adverse impacts to these lands due to the greater intensity of resource uses and the amount of surface disturbance under this alternative. Overlapping special designations under alternatives A and D (in areas not designated as Wild Lands) also provide some protection for wilderness characteristics in LWCs. No special designations under Alternative C overlap LWCs. Under Alternative A, 10,778 acres of WSR eligible waterway segments and 29,794 acres of ACEC designations would overlap LWCs. Under Alternative D, 52,418 acres of LWCs are overlapped by ACECs; 9,270 acres of ACEC designations would overlap LWCs not managed as Wild Lands.

Alternatives B and D, respectively, would result in the greatest beneficial impacts to wilderness characteristics in LWCs by restricting or limiting resource uses and activities that could degrade wilderness characteristics in designated Wild Lands. Management actions under alternatives B and D that protect designated Wild Lands would restrict, and thereby adversely affect, resource uses and certain activities (e.g., motorized vehicle use) to maintain the naturalness and opportunities for solitude and primitive, unconfined recreation in these areas. However, the comparatively more restrictive management mineral resources and ROW development under alternatives B and D would benefit other resources in Wild Land areas, such as soils, primitive and back country recreation, and visual resources.

4.6.6.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Under all alternatives, any surface-disturbing activity, including fire and fuels management, paleontological and cultural excavations, ROWs and renewable energy development, and the maintenance of existing facilities may result in adverse impacts to wilderness characteristics in LWCs. Hazardous fuels treatment and activities to control wildland fire, such as the construction of fire breaks, result in surface disturbance that may result in adverse impacts to wilderness characteristics in LWCs. Motorized vehicle use can also disturb vegetation and contribute to the spread of invasive species that degrade native vegetation communities and diminish wilderness characteristics. Livestock grazing can also contribute to the spread of invasive species, and concentrated livestock grazing can compact soils and degrade riparian/wetland areas. Facilities maintenance can require the use of mechanized equipment and vehicles and can alter the natural state of vegetation and affect wilderness characteristics.

Under alternatives A and C, LWCs do not have special management prescriptions and would therefore not affect other resources and resource uses. The types of impacts to LWCs projected due to management under alternatives A and C are similar. However, the intensity of impacts to wilderness characteristics would vary. The analysis of alternatives B and D focuses on the impact of special management prescriptions for Wild Lands to other resources and resource uses. Under all alternatives, management actions are subject to valid existing rights. The exercise of valid existing rights may be incompatible with protection of wilderness characteristics and may result in impact to wilderness characteristics. Valid existing rights include, but are not limited to, mining claims and oil and gas leases.

Alternative A

Surface Disturbance

Management actions under Alternative A are projected to result in approximately 136,415 acres of short-term and 15,710 acres of long-term surface disturbance on BLM-administered land over the life of the plan. Adverse impacts may increase with the amount of total Planning Area surface disturbance, as LWCs do not have any special management prescriptions under Alternative A. Surface disturbance is likely to result in adverse impacts to these lands by compromising wilderness characteristics.

Resource Uses

Alternative A does not contain specific management for LWCs that would constrain resource use; however, the management of certain resource uses under Alternative A may cause impacts to wilderness characteristics in these lands. Table 4-16 provides a summary of acreages and allocations associated with resources and resource uses in these lands that have the potential to affect wilderness characteristics. Management under Alternative A includes the second largest amount of area open to

mineral materials disposal and available for mineral leasing, the largest amount of area open to ROW authorizations, and the greatest amount of area where motorized vehicle use is limited to existing roads and trails. Opening LWCs to mineral development, managing areas as open to ROWs and renewable energy authorizations, and designating less restrictive travel management would result in adverse impacts to wilderness characteristics in these areas. In general, because of the intensity and extent of allowable resource uses under Alternative A, management under this alternative would result in adverse impacts to wilderness characteristics, although these characteristics are still in existence since the last wilderness review 30 years ago.

Special Designations

Special designations that overlap LWCs may result in beneficial impacts to these lands by restricting resource uses and surface-disturbing activities that can degrade wilderness characteristics, or by requiring additional mitigation for allowable activities. ACECs, WSRs, and NHTs and Other Historic Trails overlap some LWCs under Alternative A, and some of these specially designated areas include management that would reduce adverse impacts to wilderness characteristics (e.g., VRM, management of surface-disturbing activities, travel designations, etc.). Resource protections provided by the management of these areas would be beneficial to wilderness characteristics in certain lands, though these impacts would vary by location and designations. Under Alternative A, 10,778 acres of WSR eligible waterway segments and 29,794 acres of ACEC designations would overlap LWCs.

Table 4-16. Acres of Management in Lands with Wilderness Characteristics by Alternative

Alternative	Mineral Closures (acres)		Rights-of-Way (acres)			Visual Resource Management Class (acres)				Travel Management (acres)				
	Minerals Material Closure	Administratively Unavailable for Mineral Leasing	Exclusion	Avoidance/Mitigation	Open	Class I	Class II	Class III	Class IV	Closed	Limited to Designated	Limited to Existing	Open	Seasonal Restrictions
Alternative A[2]	17,108	6,099	14,901	150,888	405,499	<1	137,496	137,709	295,962	3,095	176,691	386,703	0	4,798
Alternative B[3] (Wild Lands)	565,867	570,821	51,166	520,122	0	6,306[1]	564,513	160	1	10,563	517,160	0	0	43,565
Alternative C[2]	7,920	3,295	757	132,834	437,697	1	121,605	125,530	323,845	3,365	178,802	345,264	0	43,858
Alternative D[3] all LWCs/LWCs designated as Wild Lands	22,697/ 13,167	47,574/ 47,574	6,103/ 5,018	452,047/ 47,467	113,138/ 0	4/0	198,094/ 52,438	169,527/ 47	203,638/ 0	3,365/ 3,294	321,363/ 32,019	221,908/ 0	0/0	24,648/ 16,958

Source: BLM 2009a

[1] Due to differing scales of analysis, numbers do not add to the total acreage for LWCs in the Planning Area.

[2] Alternatives A and C do not contain specific management for any identified LWCs; however, the areas identified as LWCs during the inventory conducted for this Resource Management Plan Revision Project would retain that classification unless subsequent reviews or inventories indicate they no longer contain wilderness characteristics.

[3] The numbers presented for alternatives B and D reflect the management of LWCs based on geographic information system data; due to other resource considerations, the management of certain areas in these lands may be more restrictive than the overall management for Wild Lands.

< Less than

LWC Lands with wilderness characteristics

Resources

Fire and fuels management may result in adverse impacts if mechanical fuels treatments and prescribed fire result in surface disturbance or changes in the structure of vegetation that degrades wilderness characteristics. However, fuels treatments and prescribed fire may reduce the potential for future larger-scale wildfires that would result in adverse impacts to primitive and unconfined recreation in LWCs before an area recovers. The adverse impacts to wilderness characteristics in these lands would increase with the amount of treatment.

Under Alternative A, the BLM would manage visual resources in LWCs primarily as VRM Class IV (Table 4-16). In areas managed as VRM Class IV, modification of the natural environment would be allowed (via increased tolerance for surface disturbance and fewer requirements related to facility location and other types of mitigating design modifications) and there would be adverse impacts to the indentified wilderness characteristics of the areas.

Proactive Management

Alternative A does not include specific management for LWCs or make Wild Land designations.

Alternative B

Under Alternative B, the BLM would designate all LWCs as Wild Lands (571,288 acres) and would manage these areas for naturalness, outstanding opportunities for solitude, and primitive and unconfined recreation and would prescribe management actions that affect various resources, resource uses, and special designations.

Surface Disturbance

Under Alternative B, surface disturbance in Wild Lands would be less than under alternatives A, C, and D. Management actions under Alternative B are projected to result in approximately 46 percent less short-term and 31 percent less long-term surface disturbance on BLM-administered land than Alternative A. Restrictions on minerals, ROWs, vegetative treatments, and other resource uses in Wild Lands under Alternative B would further reduce the potential for surface disturbance in these areas more than the other alternatives. Reductions in surface disturbance would result in beneficial impacts to the wilderness characteristics in these lands by leaving these areas in a more natural, unmodified state.

Resource Uses

Management for Wild Lands under Alternative B designed to protect naturalness and outstanding opportunities for solitude and primitive and unconfined recreation would result in adverse impacts to other resource uses as described below, but would be beneficial to the protection of wilderness characteristics. Restrictions on mineral development, timber harvest practices, mechanical vegetation treatments, motorized vehicle use, ROWs, and rangeland improvements under Alternative B would result in beneficial impacts by maintaining wilderness characteristics in these lands. However, these restrictions may displace some resource uses and activities, such as minerals development or motorized vehicle use, which would potentially adversely affect resources (e.g., wildlife and vegetation) in areas outside of Wild Lands.

Under Alternative B, Wild Lands are administratively unavailable for oil and gas and solid mineral leasing, and closed to mineral materials disposal. This management would result in greater adverse impacts to these resources than the other alternatives (see Table 4-16), particularly in areas with development potential, because new leasing or disposal would be prohibited. The BLM would consider

measures to minimize impacts to wilderness characteristics in project level analysis. Wild Lands encumbered with valid existing rights would be impacted where development of those rights is incompatible with protection of wilderness characteristics.

Under Alternative B, Wild Lands also are closed to commercial and personal-use wood cutting, which may adversely affect forest products by reducing the area open to timber harvest compared to the other alternatives.

Under Alternative B, the BLM limits motorized vehicle use to designated roads and trails in all Wild Lands and places more restrictions on motorized vehicle use than the other alternatives (see Table 4-16), adversely affecting travel opportunities. These lands also are closed to new road construction under Alternative B, which may adversely affect CTTM by restricting the development of new routes if access issues are discovered.

Under Alternative B, the BLM would manage Wild Lands as ROW avoidance/mitigation areas, which would result in greater adverse impacts to the ability to grant ROW authorizations on these lands compared to the other alternatives (see Table 4-16).

Special Designations

Special designations cover a larger percentage of the Planning Area under Alternative B compared to the other alternatives. Special designations would benefit Wild Lands over a larger area than the other alternatives by restricting resource uses that could adversely affect naturalness and outstanding opportunities for solitude and primitive and unconfined recreation. Under Alternative B, the area of WSR suitable waterway segment overlap is the same as under Alternative A, while acres of ACEC and Wild Lands overlap would be greater than under Alternative A (104,208 acres). However, because the characteristics of these areas are already protected under Alternative B, the magnitude of the impact would be smaller than under alternatives A and D.

Resources

Under Alternative B, resources adversely affected by surface-disturbing activities or motorized vehicle use would benefit from the restriction on these activities in Wild Lands. Resources that would benefit from management under this alternative include recreation and related opportunities and experiences derived from primitive-based settings, soil, water, wildlife and special status species, and cultural and visual resources. Under Alternative B, the BLM would manage all Wild Lands as VRM Class I or II. Alternative B manages for more VRM Class I and II in these lands than any other alternative. A larger area of more restrictive VRM Class I and II areas would affect the design and occurrence of actions that result in surface disturbance, and would provide increased protection for wilderness characteristics compared to the other alternatives.

Fire and fuels management would be more restricted in Wild Lands under Alternative B than under the other alternatives. Although the BLM allows prescribed fire in these lands, it allows mechanical vegetation treatments only to restore natural resource systems. Because fuels reduction through thinning is more restricted than under other alternatives, there may be more risk of catastrophic wildfires in these areas compared to other alternatives.

Alternative C

Surface Disturbance

Surface disturbance would result in impacts to wilderness characteristics in inventoried LWCs similar to Alternative A, although to a greater extent because Alternative C involves more projected surface

disturbance. Management actions under Alternative C are projected to result in approximately 80 percent more short-term (245,783 acres) and 164 percent more long-term (41,545 acres) surface disturbance on BLM-administered land than Alternative A. Adverse impacts are likely to increase with the amount of total Planning Area surface disturbance, because LWCs do not have any special management prescriptions under Alternative C. Adverse impacts to wilderness characteristics from surface disturbance in these lands would be the greatest under Alternative C.

Resource Uses

The impacts from resource uses to wilderness characteristics in LWCs under Alternative C would generally be similar in extent to Alternative A and would result from the same types of resource use. Table 4-16 summarizes acreages and allocations associated with resources and resource uses in these lands that have the potential to affect wilderness characteristics. Management under Alternative C includes the largest areas open to mineral materials disposal and available for mineral leasing, and the second largest area open to ROW authorizations and where motorized vehicle use is limited to existing roads and trails. Alternative C is generally the least restrictive alternative in terms of allowable resource uses and resource protection, and although the extent of impacts would be similar to Alternative A, the intensity of these impacts under this alternative may result in the greatest adverse impacts to wilderness characteristics in inventoried lands.

Special Designations

Special designations that overlap LWCs may result in beneficial impacts to wilderness characteristics by restricting resource uses and surface-disturbing activities or requiring additional mitigation. Due to the limited extent of lands with special designations under Alternative C, the potential beneficial impacts to wilderness characteristics in these lands would be lowest under this alternative. Under Alternative C, 4,857 acres of ACEC designations overlap LWCs.

Resources

Impacts to wilderness characteristics in LWCs from fire and fuels management would result in impacts similar to those under Alternative A, although to a greater extent. In general, the extent and intensity of fuels treatment under Alternative C are greater than under the other alternatives. Adverse impacts to wilderness characteristics in these lands would be proportional to the amount of treatment.

Under Alternative C, LWCs include more VRM Class III and IV areas and less VRM Class I and II areas than any other alternative. Visual management in these lands under Alternative C would have the greatest potential to result in adverse impacts to wilderness characteristics compared to the other alternatives.

Proactive Management

Alternative C does not include specific management for LWCs.

Alternative D

Under Alternative D, the BLM would designate nine LWCs as Wild Lands (52,485 acres) and would manage these areas for naturalness, outstanding opportunities for solitude, and primitive and unconfined recreation and would prescribe management actions that affect various resources, resource uses, and special designations. Similar to alternatives A and C, LWCs not managed as Wild Lands under Alternative D would not be managed to preserve the areas' wilderness characteristics. Some Alternative D Wild Lands are smaller than the original inventoried LWC area to improve manageability considering valid existing rights, land status within and surrounding the LWC, and other elements of Alternative D, such as ACECs, Management Areas, and Recreation Management Areas.

Surface Disturbance

Similar to Alternative A, surface disturbance would result in adverse impacts to wilderness characteristics in LWCs not designated as Wild Lands, although to a slightly greater extent because Alternative D involves more projected surface disturbance. Management actions under Alternative D are projected to result in approximately 3 percent more short-term (140,508 acres) and 17 percent more long-term (18,443 acres) surface disturbance on BLM-administered land than Alternative A. Adverse impacts are likely to increase with the amount of total Planning Area surface disturbance, because the majority of LWCs do not have any special management prescriptions under Alternative D.

In LWCs designated as Wild Lands, restrictions on minerals, ROWs, vegetative treatments, and other resource uses under Alternative D would reduce the potential for surface disturbance in these areas, and would result in impacts similar to Alternative B, though to a lesser extent as less acreage is designated as Wild Lands.

Resource Uses

LWCs not designated as Wild Lands under Alternative D would, similar to alternatives A and C, not constrain resource uses, which may result in adverse impacts to wilderness characteristics in these lands; however, similar to Alternative B, this alternative contains more restrictive management for nine LWCs designated as Wild Lands. Table 4-16 summarizes acreages and allocations associated with resources and resource uses in LWCs and Wild Lands that have the potential to affect these characteristics. Management under Alternative D includes the second smallest amount of area open to mineral materials disposal and the second smallest amount of area available for mineral leasing. ROW authorizations would be constrained in LWCs and Wild Lands through the designation of ROW avoidance/mitigation and exclusion areas on 458,150 acres, and the second most area would be limited to designated roads and trails for motorized vehicle use. Recreation management areas where they contain LWCs and/or Wild Lands, especially the Absaroka Mountain Foothills SRMA and Tatman Mountains RMZ containing 3,043 and 24,017 acres, respectively, would beneficially affect wilderness characteristics by preserving the back country RSCCs in these areas.

In general, management of resource uses in LWCs under Alternative D is similar to that under Alternative A, although more mitigation and reclamation requirements under Alternative D would limit impacts to wilderness characteristics. Management of resource uses in Wild Lands would be similar, though less restrictive, than management under Alternative B and would protect wilderness characteristics in these areas.

Special Designations

Several special designations overlap LWCs and/or Wild Lands under Alternative D. In LWCs not designated as Wild Lands, restrictions on surface disturbance and constraints on resource uses from overlapping special designations would limit adverse impacts to wilderness characteristics. These beneficial impacts to LWCs would be similar to those described under Alternative A, although to a greater extent due to the larger area of overlapping ACECs (52,418 acres).

Resources

Impacts to wilderness characteristics in LWCs not designated as Wild Lands from fire and fuels management would result in impacts similar to those under Alternative A, while impacts in Wild Lands would be the same as under Alternative B.

Under Alternative D, the BLM would manage more acreage in all LWCs as VRM Class I and II than under alternatives A and C, but less than Alternative B. Wild Lands are managed as VRM Class II under

Alternative D, and benefits to wilderness characteristics from this management would be the same as under Alternative B, though to a lesser extent due to the smaller number of designated Wild Lands.

4.6.7 Livestock Grazing Management

Adverse impacts to livestock grazing management result from management actions that limit, reduce, or prohibit livestock grazing or AUMs in the Planning Area. Additionally, management actions that degrade rangeland health (e.g., the condition of soils, watersheds, and vegetation communities) and livestock forage or that restrict the placement, construction, or maintenance of range improvement projects would result in adverse impacts. Management actions that are beneficial to livestock grazing include those that increase AUMs, decrease restrictions on the grazing of livestock, improve rangeland health or livestock forage, distribute or disperse livestock in ways that increase access to forage, or reduce the cost associated with livestock grazing management.

Direct impacts to livestock grazing result from management actions that change AUM allocations or restrict livestock grazing. Indirect impacts to livestock grazing result from management actions that affect rangeland health and productivity or that change livestock grazing management on BLM-administered lands with the Planning Area.

4.6.7.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Surface disturbances reduce the amount of forage available to herbivory use and can be short- and long-term (Appendix T).
- Surface disturbances increase the likelihood for the introduction and spread of invasive species, which degrade rangeland health and impact forage quality and quantity.
- To varying degrees, areas of concentrated herbivory use exist in most allotments (i.e., riparian/wetland areas, salting areas, fence corridors, etc.). Range improvements and managed livestock grazing methods disperse livestock and minimize livestock concentrations.
- Grazing management practices such as season of use and kind of livestock and stocking level modification, rotational grazing, and temporary closures can maintain or improve rangeland health and ensure the achievement of *Wyoming Standards for Healthy Rangelands* (Appendix N).
- Range improvements would include the following types of projects: spring/seep development and protection, reservoirs and pits, wells, new or modified fencing, vegetation treatments, and pipelines.
- Any changes in grazing management, including changes in grazing preference, would be based on rangeland monitoring and documented field observations, in accordance with grazing regulations (43 CFR 4110.3).
- Management actions for other resource uses (e.g., oil and gas leasing) can affect livestock grazing allocations and management.
- Managing wildlife and special status plants and wildlife can affect livestock grazing allocations.

- If a portion of an allotment is closed to livestock grazing, a proportional loss of AUMs in that allotment would result. Issues related to compensation of permittees or lessees for the loss of use of range improvements in allotments closed to livestock grazing would be addressed at the time an allotment is closed, and in accordance with regulations at 43 CFR 4120.3–6.

4.6.7.2 Summary of Impacts by Alternative

Principle impacts to livestock grazing would result from actions that limit the area available to livestock grazing and reduce the number of AUMs in the Planning Area. Overall, Alternative B would result in the greatest adverse impacts to livestock grazing, followed by alternatives A and D. Alternative C, under which the BLM would manage resources in the Planning Area to increase commodity production, would result in the greatest beneficial impacts to livestock grazing. Alternative B would place the most restrictions on the production and utilization of forage by livestock and the placement and construction of range improvements. In addition, under Alternative B, the BLM would close areas in elk and bighorn sheep crucial winter range and greater sage-grouse Key Habitat Areas, a large portion of the Planning Area, to livestock grazing.

Alternative C places the fewest restrictions on livestock grazing management and livestock forage production and utilization. Livestock grazing management under alternatives A and D – the alternatives most likely to apply management actions on a case-by-case basis – would generally result in a continuance of current grazing practices. Impacts to livestock grazing from the protection of other resources, such as wildlife and cultural resources, are generally less adverse under Alternative C than under the other alternatives. Proactive management under Alternative C would benefit livestock grazing the most because it focuses on maximizing livestock forage use. Because there would be fewer restrictions on other resource uses such as mineral development, Alternative C would result in the greatest loss in AUMs from surface-disturbing activities, with a short-term loss of 1,170 AUMs per year, followed by alternatives D, A, and B with short-term losses of 669, 650, and 352 AUMs per year, respectively. Over the long term, closing areas to livestock grazing and long-term surface disturbance would result in the greatest loss of active AUMs under Alternative B (163,927 AUMs), followed by Alternative C (4,130 AUMs), Alternative D (1,930 AUMs), and Alternative A (1,670 AUMs).

4.6.7.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Resource Uses

Impacts on livestock grazing would generally be the result of activities affecting forage quantity/production or quality in grazing allotments, such as vegetation treatments, and management that constrains or enhances livestock grazing management. Surface-disturbing activities, fire and fuels management and vegetation treatments, invasive species, grazing and surface-disturbance restrictions intended to protect resources, and proactive management actions have the greatest impact on livestock grazing in the Planning Area.

Mining of locatable, leasable, and salable minerals would affect soils and vegetation communities and would result in a loss of forage in developed areas. Surface-disturbing and disruptive activities associated with all types of mineral and geophysical exploration and development are subject to the *Wyoming BLM Standard Mitigation Guidelines for Surface-Disturbing and Disruptive Activities* (Appendix H), which would help to reduce impacts to livestock forage through the application of standard mitigation. Compared to the other minerals, locatable minerals development would result in the largest

acreage of surface disturbance and would have the greatest short-term and long-term impacts to available livestock forage.

The revegetation of disturbed areas, resulting from reclamation of oil and gas drilling and other operations, would occur under all the alternatives and would reduce the long-term adverse impacts to forage. Even with successful reclamation, there may be a permanent loss of available livestock forage in the form of limited or lost access to grazing areas from road and industrial facility development. This development may result in temporary or long-term closure of affected allotments or in reductions in grazing preference in developing or producing gas fields. The construction and improvement of roads associated with minerals development may provide livestock operators with better access to livestock and would enhance their ability to maintain improvements. Disturbed areas associated with nonproducing wells would result in short-term impacts, as they would be reclaimed quickly and most forage production would be restored. Typically, livestock concentrate on newly reclaimed areas and forage utilization decreases on the native rangeland. Although utilization levels may vary from year to year, utilization levels that remain consistently high would not be expected to meet watershed and vegetation management objectives. Adjustments in livestock management to meet these objectives may result in temporary adverse impacts. Appendix W describes the appropriate utilization levels for key species in the Planning Area.

The presence and extent of invasive plant species in an area affects rangeland health and forage productivity. Invasive plant species displace native vegetation and, because they typically are unpalatable to livestock and wildlife, often remain ungrazed. Invasive plant species may spread or become established as a result of surface-disturbing activities, motorized vehicle use, or dispersal by livestock or wildlife. Surface-disturbing activities include mechanical disturbance, such as construction of well pads, roads, pits, reservoirs, pipelines, and powerlines; mining; and vegetation treatments. Even when reclamation occurs, allotments where surface-disturbing activities have occurred may experience increased invasive plant species infestations over both the short and long term. The prevention and treatment of areas infested with invasive species are required under all alternatives. Management of invasive species would temporarily displace livestock and reduce the available forage, but would also maintain or improve rangeland health and forage quality over the long term.

Land disposals would result in adverse impacts if they reduced the available AUMs in active grazing allotments. Typically, land disposals occur on small, isolated parcels of BLM-administered land, with the goal being the consolidation of land ownership to enhance management of resource values. Exchange is the preferred method for all land tenure adjustments, and changes in AUMs resulting from any exchange would be site-specific and depend on the qualities of the both the disposal and acquisition parcels. However, because the land acquired is often located some distance from the disposal parcels, impacts to individual allotments due to AUM loss may occur.

The development of ROWs would result in both short-term and long-term reductions in forage. ROW authorizations for permanent facilities or roads would result in long-term reductions in forage. ROW authorizations that include only initial disturbance would be reclaimed to reduce long-term impacts to livestock grazing resulting from reductions in forage.

Allowing motorized vehicle use and recreational use and development would result in adverse impacts to livestock grazing through damage to soils and livestock forage, but would also benefit livestock grazing management activities. Adverse impacts from allowing motorized vehicles may include gates being left open by recreationists, the displacement of livestock from heavily used areas, or a reduction in forage palatability from the spread of invasive plants along motorized travel corridors and an increase in dust on forage near areas of heavy motorized vehicle use. Beneficial impacts from less restrictive motorized vehicle use management would include improved access for permittees to reach livestock

and to develop range improvements; closures would result in adverse impacts to access for permittees with allotments in these areas.

Provided resource damage does not occur and new roadways are not created, the BLM authorizes necessary tasks requiring off-road use of motorized vehicles under all the alternatives in areas not designated as closed to motorized vehicle use.

The BLM allows the development of range improvement projects (e.g., fences and spring developments) in portions of the Planning Area under all the alternatives, which would generally result in long-term beneficial impacts to rangeland health and livestock grazing management. Range improvement projects allow livestock managers and permittees to better implement grazing management practices and manage the distribution and movement of livestock in allotments. Adverse impacts associated with the construction of fencing, water pipelines, and other range improvements would include short-term impacts to forage; revegetation would usually occur within several growing seasons. Long-term adverse impacts associated with the construction of range improvements may include undesirable changes to livestock grazing patterns and distribution in an allotment, congregation of livestock and wildlife around new water sources, and changes in livestock trailing patterns that alter vegetation or affect rangeland health. Any long-term adverse impacts from range improvements would be site-specific in nature.

Special Designations

Prohibition of surface-disturbing activities associated with some special designations would result in adverse impacts to livestock grazing because they would limit the ability to construct range improvements (e.g., along the Nez Perce [Neeme-poo] NHT) or require additional mitigation for their construction (e.g., the Brown/Howe Dinosaur Area ACEC) that may increase the cost of such improvements.

Resources

Management actions to prevent or mitigate soil loss would generally result in beneficial impacts to vegetation, which would increase livestock forage production and quality. All alternatives maintain existing watershed improvement projects; use BMPs to reduce runoff, soil erosion, and sediment yield; and subject all surface-disturbing activities associated with mineral and geophysical exploration and development to application of the *Wyoming BLM Standard Mitigation Guidelines for Surface-Disturbing and Disruptive Activities* (Appendix H). Projects designed to enhance watershed health would enhance vegetation resources by reducing erosion and improving water quality, thereby increasing forage and water for livestock over the long term. However, adjustments in livestock management that may be needed to meet or maintain riparian habitat requirements, PFC, and water quality objectives may result in temporary adverse impacts. Surface disturbance associated with the implementation of such watershed enhancement projects would also result in short-term site-specific adverse impacts to livestock forage.

Water can be a limiting factor for livestock grazing management, especially during drought, affecting livestock survival and distribution. Water developments designed to provide new water sources for wildlife or livestock would result in beneficial impacts to livestock through increased water availability. New water sources may also promote improved distribution of livestock by opening areas to grazing where a lack of water was previously the limiting factor.

The continued closure of 4,805 acres along the Bighorn River to most livestock grazing occurs under all alternatives and would restrict livestock grazing in the area and reduce the available forage base.

Wildland fire and fuels management would have varying impacts to livestock grazing, depending on fire size, intensity, and climatic factors. Wildland fire may result in adverse impacts such as the spread of

invasive plant species, the destruction of range improvements, the displacement of livestock, and short-term impacts to livestock forage. With proper stabilization and rehabilitation, long-term impacts of wildland fire would generally be beneficial due to improvements in forage quality, quantity, and availability following the fire. For a period after a fire in shrubland communities, there would be enhanced forage production as herbaceous vegetation becomes temporarily dominant.

Vegetation treatments designed to reduce fuel hazards, improve wildlife habitat, enhance vegetation production or plant community health, or regenerate plant communities would result in long-term beneficial impacts to livestock grazing by increasing forage availability. Vegetation treatments would also result in short-term reductions in forage even though they are designed and conducted in accordance with the rangeland health requirements in the *Wyoming Standards for Healthy Rangelands* (Appendix N).

Wildlife and special status species habitat management would affect livestock grazing by restricting the placement of range improvement projects and potentially affecting the ability to implement grazing management practices. Management of greater sage-grouse habitat, white-tailed prairie dog towns, and the Bighorn River HMP/RAMP and Yellowtail Wildlife Habitat Management Area would affect the location, cost, required mitigation, and design standards and BMPs of range improvements. In addition, the maintenance of sagebrush and understory diversity in crucial seasonal greater sage-grouse habitat may result in an adverse impact by reducing the time livestock could graze in an area, changes in seasons of use, and, in some cases, result in temporary removal of livestock until vegetation treatments are in place. In areas where DPC is being met, current grazing practices would continue and there would be no adverse impacts. Wild horses and livestock generally rely on the same resources, so the appropriate management level (i.e., herd size) of wild horses in the Planning Area may affect forage availability for livestock. The initial appropriate management levels in the two HMAs do not vary across alternatives.

Cultural and paleontological resource management may have adverse impacts to livestock grazing through the removal of forage during site excavations, or through restrictions on the design and placement of range improvements. For example, the BLM requires avoidance of surface-disturbing activities in areas near scientifically significant paleontological resource sites, which may affect the placement of range improvements. VRM may also affect the location or design of range improvements in visually sensitive areas.

Proactive Management

The application of the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N), BMPs, requirements that forage supplements be weed free, the use of rangeland health assessments, and the development of range improvement projects would result in beneficial impacts to livestock grazing from increased forage quality and quantity and improved rangeland health. The intent of any grazing management practices and range improvement projects is to improve the quality or quantity of forage, thereby enhancing grazing management flexibility. These practices may increase costs to the livestock permittees associated with increased livestock herding and maintenance of range improvements. Under all alternatives, AMPs remain in effect or are revised as necessary, and the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* are applied across the Planning Area. Livestock grazing management actions are designed to enhance rangeland health, improve forage for livestock, and meet other multiple-use objectives through the application of these standards, other appropriate BMPs (see Appendices L and W), and the use of appropriate range improvements.

Alternative A

Surface Disturbance

Management actions under Alternative A are projected to result in approximately 136,415 acres of surface disturbance on BLM-administered land over the life of the plan (Appendix T); this disturbance would result in the short-term loss of approximately 12,991 AUMs, or roughly 650 AUMs per year. Most of this acreage, 120,705 acres, would be reclaimed in the short term, reducing the long-term loss of AUMs. Table 4-17 lists the total long-term loss of AUMs under Alternative A due to surface disturbance and the loss of active AUMs due to livestock grazing closures (Map 65). The baseline active AUMs for the Planning Area were 305,887 in 2009 and, therefore, the loss of AUMs under this alternative would represent less than a 1 percent reduction.

Table 4-17. Change in Active Animal Unit Months (AUMs) by Alternative

	Alternative A	Alternative B	Alternative C	Alternative D
Acres Closed to Livestock Grazing	5,172	1,988,927	5,171	5,172
AUMs Lost[1]	*173*	*162,890*	*173*	*173*
Acres of Long-Term Disturbance	15,710	10,882	41,545	18,443
AUMs Lost[2]	*1,496*	*1,036*	*3,957*	*1,756*
Total Loss of AUMs (long term)	**1,670**	**163,927**	**4,130**	**1,930**

Source: BLM 2009a
[1]Active AUMs in grazing allotments.
[2]Because it is not possible to determine the exact allotments where there will be surface disturbance, AUMs lost to long-term surface disturbance were calculated using the Planning Area average of 10.5 acres per AUM.

Resource Uses

Silviculture treatments may benefit livestock grazing management where they reduce canopy cover and increase understory forage. Under Alternative A, precommercial thinning in overstocked and regenerated timber sale areas for trees in the 20- to 30-year age class, timber harvesting in commercial forestland to protect and benefit ecosystem functions, and clear cuts subject to certain stipulations may benefit livestock grazing management. The use of silvicultural treatments may also result in beneficial impacts by moving forests and woodlands towards DPC, though the degree to which these treatments would move areas towards DPC would depend on the location, timing, and other factors of treatments. Silvicultural treatments that move areas toward DPC would make more forage available for herbivory by stimulating herbaceous plant growth in the forest and woodland understory.

Alternative A may result in additional expense or delay to grazing permittees as it allows livestock flushing on a case-by-case basis to avoid the dispersal of invasive species.

Under Alternative A, the BLM closes approximately 59,192 acres to motorized vehicle use. These closures may have an adverse impact on permittee access to livestock and range improvements but would result in a beneficial impact to rangeland health and forage palatability, as described under Impacts Common to All Alternatives.

Special Designations

Special designations under Alternative A would result in adverse impacts to the development of range improvements due to management that prohibits, or requires avoidance of, surface-disturbing activities.

ACECs under Alternative A with such management include Red Gulch Dinosaur Tracksite, Sheep Mountain Anticline (above caves and cave passages), Carter Mountain, Five Springs Falls, and Upper Owl Creek. Alternative A also requires avoidance of surface-disturbing activities in view within ¼ mile of the Nez Perce (Neeme-poo) NHT and the Bridger Trail and Fort Washakie to Meeteetse to Red Lodge Trail and prohibits the construction of range improvements along 11 WSR eligible segments. Other areas, such as the Brown/Howe Dinosaur Area ACEC, require mitigation or avoidance of impairment following surface disturbance to limit adverse impacts to vegetation.

Under Alternative A, the management of the Red Gulch Dinosaur Tracksite ACEC and all WSR eligible waterway segments may restrict livestock grazing use. Alternative A closes the interpretive area of the Red Gulch Dinosaur Tracksite ACEC to livestock grazing and manages all WSRs to prevent an increase in actual grazing use. The closure of the interpretive area would not affect the AUMs for the surrounding allotment, but restrictions on grazing in the WSR eligible segments would prohibit any upward adjustments to grazing in these areas, regardless of on-the-ground rangeland conditions.

Resources

Under Alternative A, the BLM routinely seeds, or requires permittees and operators to seed, disturbed areas with native plant species and requires that vegetation cover of disturbed soils be reestablished within 5 years of initial seeding. These reclamation requirements would benefit livestock forage by promoting short-term forage recovery in areas where surface disturbance has occurred and preventing degradation of rangeland health due to soil loss.

Under Alternative A, beneficial long-term impacts to grassland and shrubland health would occur by managing grassland and shrubland communities within 600,000 acres of BLM-administered land toward DPC objectives for watershed protection and livestock grazing. Managing towards DPC objectives improves forage for livestock and wildlife, improves overall DPC health and plant vigor, and reduces potential erosion. However, because these management actions are implemented on only a small fraction of grassland and shrubland communities, Alternative A would have limited beneficial long-term impacts to grassland and shrublands and associated forage for herbivory.

Allowing the surface discharge of produced water if it meets state of Wyoming water quality standards and making this water available for use on a case-by-case basis would benefit livestock by increasing water availability and may improve livestock distribution.

Management under this alternative prohibits surface-disturbing activities within 500 feet of surface water and riparian/wetland areas (55,586 acres) except when such activities are necessary and their impacts can be mitigated, which may affect the use of range improvements. This management may result in adverse impacts to the placement of range improvements in these areas or increased costs from increased mitigation requirements.

Under Alternative A, the BLM manages wildland fires to restore fire-adapted ecosystems and to reduce hazardous fuels, resulting in short-term adverse impacts from forage loss, but long-term beneficial impacts to forage production. The impact of management under this alternative would be progress towards a balance of herbaceous and woody vegetation in treated areas that would provide forage for livestock. Reducing the accumulation of hazardous fuels would have the beneficial impact of reducing the risk of catastrophic wildfires. In areas where fuels exceed historical levels, intense fires would result in the loss of forage over an area, as they may destroy the seeds of perennial grasses and shrubs and alter soils in ways that increase the risk of invasive species establishment. Alternative A would result in the second-greatest area of fuel treatments and prescribed fire with proportional impacts to livestock grazing.

Most of the total projected prescribed fire and fuels treatment acreage (70,000 acres) under Alternative A would be applied to grassland and shrubland communities not meeting DPC objectives. FRCC Classes 2 and 3 have the highest risk of catastrophic fire or of having lost or losing key ecosystem components. There is a risk in these areas that the vegetation management acreage under Alternative A would be inadequate to reduce fuel conditions enough to substantially diminish the risk of catastrophic fire and prevent associated adverse impacts to livestock grazing.

Alternative A prohibits the placement of salt, mineral, or forage supplements within ¼ mile of water, wetlands, riparian areas, reclaimed or reforested areas, or as determined by the authorized officer, which would beneficially impact livestock by distributing herbivory to maintain vegetation health and plant vigor across the landscape but may restrict permittees' flexibility in the placement of range improvements to maximize livestock grazing use.

Wildlife management actions under Alternative A would generally result in adverse impacts to livestock grazing. Alternative A prohibits livestock grazing in elk parturition habitat (55,952 acres) during the birthing season (usually from May 1 through June 30) and domestic sheep grazing on pronghorn crucial winter range unless adverse effects can be avoided or mitigated based on site-specific analysis; existing uses are allowed pending site-specific analysis. Seasonal prohibitions against livestock grazing would require fencing, management actions such as herding, changes in season of use, or the closure of allotments. Management under Alternative A would therefore increase management costs and limit the areas open to livestock grazing, but may have the beneficial impact of reducing the transmission of brucellosis between elk and cattle by limiting wildlife-livestock contact.

Wildlife management actions that avoid or prohibit surface-disturbing activities under Alternative A also restrict the location, cost, and timing of range improvement project construction and maintenance. Generally, Alternative A determines wildlife seasonal protections for surface-disturbing and disruptive activities related to the maintenance and operation of projects on a case-by-case basis. Specific restrictions to range improvements include a prohibition on new water developments for livestock in elk crucial winter range (unless adverse impacts can be avoided or mitigated) and direction to retain riparian vegetation when cleaning or removing sediment from wet reservoirs where feasible. Prohibitions on new water developments would have adverse impacts to the placement of range improvements, and may result in the placement of projects in locations that are not optimal for livestock grazing management. Additional design requirements or mitigation would increase the cost of range improvement construction and maintenance.

The management of special status species under Alternative A would result in adverse impacts to livestock grazing. Under Alternative A, the BLM reviews all range improvement projects for potential impacts to special status plant species and can require avoidance or mitigation measures on a case-by-case basis. Adverse impacts to the location and cost of range improvements may result, and would be of a similar type to those identified under impacts from wildlife management.

The application of Standard Paleontological Resources Protection Stipulations (see *Glossary*) to authorizations for surface-disturbing activities on PFYC 3, 4, or 5 formations, including a prohibition of surface-disturbing activities within at least 50 feet of the outer edge of the paleontological locality, may have adverse impacts to the placement of range improvement projects.

Under Alternative A, the Planning Area is managed primarily as VRM Class III and IV, with only approximately 15 percent managed as VRM Class I and II. Depending on their visibility, range improvement projects in areas managed as VRM Class I or II may need to be designed to minimize their contrast with the surrounding landscape or placed in locations where they are less likely to attract the

attention of viewers. In Class I and II areas, this may result in adverse impacts to grazing management through additional costs to permittees and restrictions on the placement of range improvements.

Proactive Management

Under Alternative A, most of the Planning Area is open to livestock grazing and management of grazing is designed to provide for protection or enhancement of other resource values. Areas closed to livestock grazing include campgrounds, exclosures, and areas specifically closed under the Management Actions Common to All Alternatives.

Limited, but beneficial impacts to livestock grazing would result from the apportionment of any additional sustained yield forage to meet multiple-use objectives, after meeting DPC objectives, and to satisfy the suspended permitted use of permittees/lessees (148,394 AUMs) in the allotment where the forage is available. While this management would help to replace suspended AUMs, the focus would remain on meeting broader multiple-use objectives.

Alternative A requires range improvement projects be designed to meet allotment management objectives, resulting in localized beneficial impacts. The focus of these projects under Alternative A would be to meet multiple-use objectives.

The issuance of permits/leases for livestock grazing on parcels that are not currently included in grazing allotments would increase available AUMs. The increase in actual forage may be limited due to the small size of most unallocated parcels and the expense and challenge of managing these areas.

Reserve common allotments are not considered under this alternative, which would reduce the flexibility of providing alternate forage options to permittees whose allotments are rested following rangeland restoration activities.

Alternative B

Surface Disturbance

Management actions under Alternative B are projected to result in approximately 73,919 acres of surface disturbance on BLM-administered land over the life of the plan; this disturbance would result in the short-term loss of approximately 7,040 AUMs, or roughly 352 AUMs per year. Most of this (63,037 acres) would be reclaimed in the short term, reducing the long-term loss of AUMs (see Table 4-17). The total long-term loss of AUMs under Alternative B due to surface disturbance and the loss of active AUMs due to livestock grazing closures (Map 66) would be 163,927 AUMs (an approximately 54 percent reduction from the baseline active AUMs for the Planning Area). The projected surface disturbance under Alternative B would result in the least long-term and short-term adverse impact to AUMs due to loss of forage of any of the alternatives; however, the total AUM loss from closures under this alternative is larger than under any other alternative.

Resource Uses

The use of silvicultural treatments would result in benefits similar to Alternative A, although to a lesser extent because the BLM would treat less acreage under Alternative B. Prohibiting clear cuts and precommercial thinning for reasons other than fuel reduction and restricting timber harvesting to areas where natural processes are unable to accomplish forest health goals would result in a more closed canopy than Alternative A. Therefore, although areas would still be moved toward DPC, less understory vegetation would be available for grazing compared to Alternative A.

Impacts from livestock flushing would be similar to Alternative A.

Alternative B closes approximately 136,474 acres of BLM-administered land to motorized vehicle use, an increase of approximately 131 percent over Alternative A, which would result in fewer impacts to rangeland health and forage palatability but may have the greatest adverse impact to permittee access to livestock and range improvements compared to the other alternatives.

Special Designations

Adverse impacts to the construction of range improvements would be greater under Alternative B because the alternative designates more ACECs and expansion areas, and more restrictive management in special designations. Under Alternative B, the BLM would manage seven of the ACECs to limit or prohibit surface-disturbing activities, and this alternative would expand the area where surface-disturbing activities are avoided to include areas in view within 5 miles of NHTs, other trails, and National Historic Landmarks. Alternative B would also result in the greatest adverse impacts to the construction of range improvements along WSR suitable waterways, prohibiting their construction along all segments.

Unlike alternatives A and C, the designation of LWCs as Wild Lands under Alternative B may adversely affect the ability to construct range improvements projects, because these projects are only allowed where their short-term adverse impacts to wilderness characteristics can be mitigated. Mitigation requirements may increase the cost of range improvements in these areas or may prohibit these developments altogether if mitigation is not possible.

Resources

Under Alternative B, the BLM requires the reestablishment of healthy native plant communities in disturbed areas to 50 percent pre-disturbance levels of desired vegetative cover within three growing seasons and 80 percent within 5 years. Though the use of native plants may slow reclamation time, the vegetative cover requirements under this alternative would result in the greatest short- and long-term benefits to livestock by requiring the most amount of forage restoration in the shortest amount of time. These reclamation requirements would have the greatest beneficial impact to livestock grazing. Long-term beneficial impacts to forage quality and stability would also result from the reestablishment of native plant communities.

Alternative B would result in the least acreage of vegetation treatments (Appendix T). Alternative B would result in a limited beneficial impact towards improving vegetation conditions to achieve or make progress towards achieving 75 percent or more of Historical Climax Plant Community in all grasslands and shrublands described by this alternative. This alternative would be the least effective at moving these vegetation communities towards DPC objectives, and would result in less beneficial impacts, such as the improvement in forage for livestock, to rangeland health described under Alternative A.

Prohibiting the surface discharge of produced water and surface-disturbing activities within ¼ mile of riparian/wetland areas (140,464 acres) would reduce or remove beneficial impacts to livestock grazing realized under the other alternatives. Eliminating the surface discharge of produced water would remove a potential water source for livestock that would be available under alternatives A and C. The surface-disturbing activity prohibitions under Alternative B would affect a larger acreage than the other alternatives, and would result in a larger adverse impact on the construction of range improvements.

Vegetation treatments to reduce hazardous fuels are projected to be lowest under Alternative B (Appendix T), resulting in the smallest projected beneficial impact to long-term forage production and the highest risk of forage loss due to catastrophic wildfires.

Impacts from restrictions on the placement of salt, mineral, or forage supplements would be similar to Alternative A, although to a greater extent because under Alternative B, the buffer width increases to ½ mile from water, wetlands, riparian areas, or reclaimed or reforested areas.

Wildlife management actions under Alternative B would result in greater adverse impacts to livestock grazing than the other alternatives (Table 4-17 and Map 66). The BLM does not allow new livestock grazing use in elk parturition habitat during the birthing season (usually from May 1 through June 30) or new domestic sheep grazing on pronghorn crucial winter range under Alternative B. The closure of all crucial winter range for elk and bighorn sheep (251,402 acres) and greater sage-grouse Key Habitat Areas (1,231,383 acres) to livestock grazing would result in the loss of approximately 131,464 AUMs, or 43 percent of the total current active use AUMS in the Planning Area. Please refer to Section 4.8.2 *Economic Conditions* for additional information on the effects of changes in AUMs on livestock operations.

Impacts to the construction and maintenance of range improvements from wildlife management actions would be greatest under Alternative B. In addition to management discussed under Alternative A, Alternative B expands prohibitions on livestock water developments to include greater sage -grouse nesting areas and areas important for special status species, and also applies seasonal restrictions when the actions are determined to be detrimental to wildlife. This alternative also prohibits surface-disturbing activities within ½ mile of big game migration corridors (43,238 acres), closing these areas to new construction.

The management of special status species under Alternative B would result in the greatest adverse impacts to livestock grazing of any alternative. In addition to the management under Alternative A, Alternative B requires avoidance of reservoir work during amphibian mating and metamorphosis periods (April to July), which would adversely affect livestock permittees' ability to conduct maintenance on reservoirs. Under Alternative B, additional adverse impacts to the construction of range improvements and placement of forage supplements would occur, due to prohibitions within ½ mile of known special status plant species occurrences.

The management of cultural and paleontological resources under Alternative B would result in greater adverse impacts to the construction of range improvements than any other alternative. Under this alternative, the BLM avoids surface-disturbing activities in view within 5 miles of important cultural sites and in view within ¼ mile of significant segments of historic sites. Alternative B also prohibits surface-disturbing activities within at least 100 feet of the outer edge of the paleontological locality, regardless of PFYC.

Alternative B includes the largest percentage of VRM Class I and II areas, with more than 60 percent of the Planning Area in these most restrictive classes; therefore Alternative B would have the greatest adverse impact on the cost and placement of range improvement projects.

Proactive Management

Livestock grazing management under Alternative B focuses on meeting multiple-use objectives, rather than maximizing forage or benefits for livestock. Alternative B apportions any additional sustained yield forage primarily to wild horses and wildlife, and does not allow permits/leases on parcels not included in a grazing allotment. Therefore, Alternative B would not result in beneficial impacts to suspended forage replacement and increased AUMs from new permits and leases as would alternatives A and C. Alternative B also requires range improvements projects, including vegetation treatments, be designed to maximize multiple-use benefits.

Alternative B establishes and manages reserve common allotments on a voluntary basis, resulting in beneficial impacts to livestock grazing. Reserve common allotments would increase management flexibility and the ability to rest allotments following vegetation treatments, allowing more intensive vegetation treatments and the temporary removal of livestock for more effective rangeland recovery. Intensive vegetation treatments would contribute to vegetation class diversity and greater long-term forage production, but would also temporarily decrease forage in treated areas.

Alternative C

Surface Disturbance

Management actions under Alternative C are projected to result in approximately 245,783 acres of surface disturbance on BLM-administered land over the life of the plan; this disturbance would result in the short-term loss of approximately 23,408 AUMs, or roughly 1,170 AUMs per year. Most of this acreage, 204,238 acres, would be reclaimed in the short term, meaning that the long-term loss of AUMs would be reduced. The projected surface disturbance under Alternative C would result in the greatest long-term (Table 4-17) and short-term adverse impact livestock grazing due to the resulting loss of AUMs. The loss of AUMs due to closing areas to livestock grazing would be similar to Alternative under Alternative A. Overall, the total loss AUMs due to closures and long-term surface disturbance under this alternative would be greater than under Alternative A and less than under Alternative B, representing a loss of just 1 percent of the baseline 305,887 AUMs (Table 4-17; Map 65).

Resource Uses

The use of silvicultural treatments would result in beneficial impacts similar to Alternative A, although to a greater extent because Alternative C treats more area. Forest and woodland management under Alternative C would result in the greatest beneficial impact to forage for livestock. Alternative C allows the most timber harvesting of any alternative, and earlier precommercial thinning and larger clear cuts than Alternative A. Under Alternative C, the BLM also manages juniper and limber pine stands to enhance livestock grazing. Activities that control juniper encroachment or stimulate herbaceous growth in the forest and woodland understory would benefit grazing because forage production would increase.

The BLM does not require livestock flushing under Alternative C. This would benefit permittees by reducing costs and allowing more flexibility to move herds, but may cause long-term adverse impacts by increasing the potential for establishment and spread of invasive species, which may reduce forage.

Alternative C closes approximately 10,636 acres of BLM-administered land to motorized vehicle use, an approximately 82 percent decrease compared to Alternative A, and would have the least adverse impact on permittee access but the largest potential impact to rangeland health and forage palatability of any alternative.

Special Designations

Alternative C would result in the least adverse impact on the construction of range improvements from the management of special designations. Impacts from the management of the Brown/Howe Dinosaur Area ACEC would be the same as under the other alternatives, but restrictions and mitigation associated with surface-disturbing activities in other areas managed as ACECs and WSRs under alternatives A and B would not occur. Impacts from the management of the NHT and Other Historic Trails would be similar to those described under Alternative A.

Resources

Alternative C would have a beneficial impact on the short-term production of forage in areas of surface disturbance. The use of nonnative and native seed mixes and a focus on increasing commodity production (e.g., livestock grazing) may result in increased short-term forage production compared to the other alternatives. However, a lower standard for the reestablishment of desired vegetative cover than Alternative B, including the use of nonnative seeding to create more short-term forage production, may result in less forage quality and stability in the long term.

Alternative C would result in the most acreage of vegetation treatments to improve vegetation conditions (Appendix T); however, no grasslands and shrublands are managed towards DPC and are instead managed to achieve or to make progress towards achieving the *Wyoming Standards for Healthy Rangelands* (Appendix N). Alternative C would result in the fewest beneficial impacts from proactive management towards achieving historical community structure and composition. However, the projected area of prescribed burns and vegetation treatments under Alternative C would result in beneficial impacts across the greatest area to achieve rangeland health standards, relative to the other alternatives.

The management of produced water and riparian/wetland areas under Alternative C would benefit livestock grazing. The surface disposal of produced water would create a larger beneficial impact for livestock grazing than under Alternative A due to a requirement that discharged water be put to use (e.g., for livestock watering). This alternative also allows surface-disturbing activities or livestock supplements in floodplains or riparian/wetland areas on a case-by-case basis, increasing permittees' flexibility in the placement of range improvements to maximize livestock grazing use but also the potential for concentrated livestock grazing to degrade long-term vegetation health and plant vigor in these areas.

Management under Alternative C emphasizes vegetation treatments as a tool to enhance livestock forage and has the largest projected area of vegetation treatments to reduce hazardous fuels (Appendix T). Depending on the FRCC class in which it occurs (see Section 4.3 *Fire and Fuels Management*), this management would result in the greatest short-term loss of forage. However, there would be more benefits to long-term forage production. Increased fire and fuels treatments would result in the smallest risk of forage loss due to catastrophic wildfires and less stress related to finding pasture for livestock following wildfire events compared to other alternatives.

Wildlife management actions under Alternative C are the least restrictive to livestock grazing management. The BLM allows livestock grazing in elk parturition habitat and domestic sheep grazing on pronghorn crucial winter range and does not apply seasonal restrictions on maintenance and operation actions to protect wildlife. Adverse impacts to livestock grazing from the elimination of approximately 131,464 AUMs within elk and bighorn sheep crucial winter range and greater sage-grouse Key Habitat Areas under Alternative B would not occur under this alternative. Alternative C would result in the least adverse impacts from wildlife management, due to surface-disturbance restrictions, on the construction of range improvements. However, management under this alternative does allow the greatest potential for contact between elk and cattle, and may increase the transmission of brucellosis.

The management of special status species under Alternative C would result in impacts to livestock grazing. Impacts to reservoir maintenance from restrictions during amphibian mating and metamorphosis periods would be the same as under Alternative A. Adverse impacts to the construction of range improvements in special status plant species habitat would be greater than under alternatives A and D, but less than under Alternative B.

The management of cultural resources under Alternative C (i.e., restricting surface-disturbing activities in view within ¼ mile of certain important cultural sites) would result in greater adverse impacts to the construction of range improvements than under Alternative A, but less than under alternatives B and D.

Adverse impacts from the management of paleontological resources would be less than the other alternatives because surface-disturbing activities are prohibited within only 50 feet of the outer edge of the paleontological locality and standard Paleontological Resources Protection Stipulations are only attached to authorizations for surface-disturbing activities in PFYC 4 or 5 areas.

Impacts from the management of visual resources on range improvements would be similar to those described under Alternative A.

Proactive Management

Management under Alternative C would be the most beneficial to livestock grazing due to its focus on maximizing livestock forage use instead of the enhancement of other resource values. The BLM apportions additional sustained yield primarily to satisfy suspended permitted use, which would result in greater beneficial impacts to livestock forage availability than under alternatives A and B, and similar impacts to those under Alternative D. Range improvements under Alternative C would also be designed to maximize livestock forage and distribution.

Under Alternative C, the BLM allows the issuance of permits/leases for unallocated parcels and does not establish reserve common allotments; the impacts would be similar to those described for this management action under Alternative A.

Alternative C does not establish reserve common allotments and would not result in the beneficial impacts afforded by these allotments described for alternatives A and C.

Alternative D

Surface Disturbance

Management actions under Alternative D are projected to result in approximately 140,508 acres of surface disturbance on BLM-administered land over the life of the plan; this disturbance would result in the short-term loss of approximately 13,382 AUMs, or roughly 669 AUMs per year. Most of this acreage, 122,065 acres, would be reclaimed in the short term, meaning that the long-term loss of AUMs would be reduced. The total long-term loss of AUMs under Alternative D due to surface disturbance and closing areas to livestock grazing would be slightly greater than under Alternative A, representing a loss of less than 1 percent of the baseline 305,887 AUMs (Table 4-17; Map 65).

Resource Uses

The use of silvicultural treatments would result in impacts similar, but to a greater extent than alternatives A and B, and a lesser extent than under Alternative C. The earlier use of precommercial thinning and clear-cut practices similar to those under Alternative C may reduce canopy cover and increase forage more than Alternative A. Other silvicultural activities and associated impacts from the management of aspen, juniper, and limber pine stands and timber harvesting would be the same as those under Alternative A.

The impacts from livestock flushing practices under Alternative D would be the same as those under Alternative A.

Alternative D closes approximately 60,681 acres of BLM-administered land to motorized vehicle use, or an approximately 3 percent increase in areas closed compared to Alternative A. Impacts to permittee access and rangeland health and forage palatability would be similar to Alternative A.

Special Designations

Adverse impacts from the management of special designations to the construction of range improvements and the availability of areas for grazing would be less than under Alternative B, but greater than under alternatives A and C. Except for the Carter Mountain ACEC, Alternative D includes all of the Alternative A ACECs, with the same management of surface-disturbing activities. Alternative D allows surface-disturbing activities across the Carter Mountain ACEC if the effects can be avoided or mitigated, which may reduce adverse impacts to the placement of range improvements. Designating some LWCs as Wild Lands (52,485 acres) under Alternative D would result in similar adverse effects to livestock grazing management as those described under Alternative B, but to a lesser extent. Similar to Alternative A, Alternative D would avoid surface-disturbing activities near NHTs and Other Historic Trails, although the area affected may be greater (i.e., the foreground of these trails up to either 3 miles [NHTs] or 2 miles [Other Historic Trails]). Unlike alternatives A and B, under Alternative D, the BLM would not manage any of the WSR eligible waterway segments as suitable for inclusion in the NWSRS, thereby eliminating any adverse impacts to range improvement placement or limitations to increases in grazing along these waterway segments. The interpretive area of the Red Gulch Dinosaur Tracksite is closed to livestock grazing under this alternative, but this management would not affect the AUMs for the surrounding allotment.

Resources

In disturbed areas, Alternative D allows the reestablishment of healthy native or DPCs based on pre-disturbance/desired plant species composition and judges successful reclamation by whether conditions are equal to or better than pre-disturbance site conditions. Reclamation practices under Alternative D would restore forage to disturbed areas more quickly than under alternatives A and C. Compared to Alternative B, this alternative provides additional flexibility that may shorten the reclamation time by allowing the use of beneficial nonnative plants, but may result in reduced long-term beneficial impacts to forage quality and stability from using nonnative species.

Alternative D would result in the same acreage of vegetation treatments as described under Alternative A (Appendix T), and would manage the vegetation communities to achieve or make progress towards achieving 65 percent or more of Historical Climax Plant Community. The impacts of this alternative on grasslands and shrublands and the associated forage would be similar to those described under Alternative A. Alternative D also would result in approximately the same acreage of burns from wildland fire as Alternative A, although the emphasis under Alternative D to use burns to accomplish other resource management objectives (e.g., livestock grazing forage improvement) may result in greater benefits to livestock forage production than Alternative A.

As under alternatives A and C, Alternative D allows the use of produced water by livestock. This alternative would result in greater beneficial impacts to livestock water availability and distribution than the other alternatives because it removes the case-by-case stipulation for the use of produced water.

Management under this alternative restricts surface-disturbing activities near surface water and riparian/wetland areas over a larger area (between 500 feet and ¼ mile), with appropriate mitigation, than under Alternative A. Such management would, therefore, result in greater beneficial impacts to vegetation health (and, therefore, forage productivity) than alternatives A and C, but less than Alternative B. However, it also may increase mitigation costs compared to Alternative C. Prohibiting the

placement of salt, mineral, and forage supplements in sensitive areas (i.e., within ¼ mile of water, wetlands, riparian areas, reclaimed or reforested areas) would result in the same impacts as Alternative A.

Wildlife management actions would generally result in fewer adverse impacts to livestock grazing management under Alternative D than under alternatives A or B, and more than under Alternative C. Limitations on livestock grazing in elk parturition habitat during the birthing season and domestic sheep grazing on pronghorn crucial winter range would result in similar impacts to those under Alternative A. Impacts from wildlife management actions that avoid or prohibit surface-disturbing activities and therefore restrict the location, cost, and timing of range improvement project construction and maintenance would be similar to those described under Alternative A. Mitigation requirements under Alternative D may be less restrictive than under Alternative A, which may result in fewer adverse impacts to the placement of new range improvements or reduced costs for range improvement construction and maintenance due to design requirements.

Adverse impacts to livestock grazing management due to the management of special status species would generally be less than under Alternative B, but more than under alternatives A and C. Alternative D includes a smaller mile avoidance area than Alternative B near BLM special status plant species populations for range improvements that may concentrate herbivory. This alternative also allows water development projects in sage-grouse nesting habitat with 10 inches or less annual precipitation if adverse effects can be avoided or mitigated based on site-specific analysis, a less restrictive requirement for allowing water development than that under Alternative B. Reservoir maintenance practices and avoiding reservoir work during amphibian mating and metamorphosis periods under Alternative D would result in similar impacts to those under Alternative B.

The management of cultural and paleontological resources under Alternative D would result in less adverse impacts to the construction of range improvements than under Alternative B, but more than under alternatives A and C. Alternative D requires the avoidance of surface-disturbing activities in view within 3 miles where setting is an important aspect of the integrity for the site and uses BMPs to avoid or mitigate adverse impacts. Similar to Alternative A, this alternative attaches standard Paleontological Resources Protection Stipulations to authorizations for surface-disturbing activities on PFYC 3, 4, or 5 formations. Unlike the other alternatives however, this alternative does not prohibit surface-disturbing activities within a certain distance from the outer edge of paleontological localities if the impacts can be mitigated and written authorization to proceed is issued by the authorized officer.

Alternative D includes the second largest percentage of VRM Class I and II areas, with more than 20 percent of the Planning Area in these most restrictive classes. Therefore, Alternative D likely would result in more adverse impacts to the cost and placement of range improvement projects than alternatives A and C, but less than Alternative B.

Proactive Management

As under Alternative A, most of the Planning Area is open to livestock grazing. Specific closures under Alternative D are the same as under Alternative A (see Table 4-17); however, unlike Alternative A, Alternative D allows livestock grazing in areas closed to livestock grazing as a tool to maintain or improve resource conditions. Under Alternative D, the BLM would manage livestock grazing to support other resource objectives, and would require mitigation for new resource uses to minimize or avoid conflicts with livestock grazing. Requiring mitigation and avoidance when a resource use conflicts with livestock grazing would result in a beneficial impact to livestock grazing management that may not occur under the other alternatives.

The design requirements, management focus, and impacts of range improvement projects under Alternative D would be the same as under Alternative A.

The management focus under this alternative – to apportion additional sustained yield to satisfy suspended permitted use of permittees/lessees and to meet multiple-use objectives – would be similar to that under Alternative A and would result in similar beneficial impacts to forage availability as under described under that alternative.

Similar to Alternative B, this alternative establishes and manages reserve common allotments on a voluntary basis, but, unlike Alternative B, this alternative also establishes reserve common allotments on abandoned allotments on a case-by-case basis thereby further increasing beneficial impacts to livestock grazing management flexibility by increasing the acreage where intensive rangeland-improving vegetation treatments could be performed. Similar to alternatives A and C, this alternative would result in beneficial impacts to livestock grazing by allowing the case-by-case issuance of permits/leases for livestock grazing for parcels that are not included in a grazing allotment.

4.7 Special Designations and Other Management Areas

4.7.1 Areas of Critical Environmental Concern

This section describes impacts related to the 18 existing, existing with proposed expansion, and new proposed ACECs in the Planning Area (see Table 4-18). The BLM manages ACECs to provide special management for relevant and important values, resources, natural systems, and natural hazards (referred to here as values of concern). This section also addresses impacts related to two other Management Areas (the Craig Thomas Little Mountain SMA and the Chapman Bench Management Area) closely related to the existing and proposed ACECs. Section 4.4.6 *Wildlife* describes the impacts of the Absaroka Front Management Area; Section 4.2.5 *Leasable Minerals - Oil and Gas* describes impacts from Oil and Gas Management Areas.

The discussion of ACECs and other Management Areas considers impacts in two ways: (1) the impacts of management in these special designations to other resources and resource uses and (2) the impacts of management to the protection of the values of concern for which the BLM proposes that designation. Most of the values of concern are resources in their own right and are further discussed and analyzed by alternative in the corresponding sections of this chapter. For example, this section describes impacts to paleontological values of concern in the Big Cedar Ridge ACEC, but Section 4.5.2 *Paleontological Resources* describes overall impacts to paleontology from management under the alternatives. The impacts analysis in this section focuses on high-level comparisons of potential adverse and beneficial impacts among the alternatives. While simply designating an ACEC would not produce effects that can be analyzed, the management prescriptions applied to the ACEC would result in effects.

4.7.1.1 Methods and Assumptions

The introduction to Chapter 4 identifies the assumptions used in this impact analysis. Assumptions related to other resources and resource uses discussed in this section apply to the analysis of ACECs and other Management Areas. There are no additional specific assumptions.

To allow for a consistent analysis, the ACEC boundaries designated under Alternative B are used as the area of analysis for all alternatives. Using Alternative B boundaries, the analysis compares the impacts of key management (e.g., mineral development, ROWs, and travel management) to resources and resource uses in these areas. When an alternative proposes an ACEC, the BLM based the determination of impacts to resources and resource uses on the management actions listed in Chapter 2. When an alternative does not propose an ACEC, the BLM based the determination of impacts to resources and resource uses on a GIS analysis of management for that area under that alternative. For example, the BLM would not manage the Big Cedar Ridge area as an ACEC under Alternative C. However, to ensure the analysis is comparable across alternatives, Alternative C describes management for minerals, ROWs, and travel for this same geographic area. The adverse and beneficial impacts of not designating this area as an ACEC under Alternative C are then compared to the adverse and beneficial impacts of managing this same area as an ACEC under alternatives A and B.

Similar to the comparison of management across alternatives described above, the BLM used the Alternative B boundaries to determine mineral potential for locatable minerals, leasable minerals, and mineral materials. Based on GIS data and information in the S*olid Mineral Occurrence and Development Potential Report* and *Reasonable Foreseeable Development Potential Report for Oil and Gas*, mineral potential was overlaid with the Alternative B area being analyzed. The BLM used the mineral potential and the specific management of minerals in the area as the basis of analysis when comparing impacts to mineral resources from management under the alternatives.

Table 4-18. Existing and Proposed ACECs and other Management Areas by Alternative

Area	Alternative			
	A	B	C	D
Existing ACECs (no expansion proposed)				
Big Cedar Ridge	X	X		X
Red Gulch Dinosaur Tracksite	X	X		X
Sheep Mountain Anticline	X	X		X
Spanish Point Karst	X	X	X	X
Existing ACECs (and proposed expansion)				
Brown/Howe Dinosaur Area	X	X	X	X
Carter Mountain	X	X		X
Five Springs Falls	X	X		X
Little Mountain	X	X		X[1]
Upper Owl Creek Area	X	X		X
Proposed ACECs				
Chapman Bench		X		X[2]
Clarks Fork Basin/Polecat Bench West Paleontological Area		X		–[3]
Clarks Fork Canyon		X		X
Foster Gulch Paleontological Area		X		–[3]
McCullough Peaks South Paleontological Area		X		–[3]
Rainbow Canyon		X		
Rattlesnake Mountain		X		
Sheep Mountain		X		X
Paleocene-Eocene Thermal Maximum (PETM)		–[4]		X

Source: BLM 2009a
[1]Although not proposed for expansion under Alternative D, the BLM manages a portion of the proposed expansion area as the Craig Thomas Little Mountain Special Management Area.
[2]Although not proposed as an ACEC under Alternative D, the BLM manages a portion of this area as the Chapman Bench Management Area.
[3]Although not proposed under Alternative D, a portion of this area falls within the proposed PETM ACEC.
[4]Although not proposed under Alternative B, the entire area of the PETM ACEC is within the Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch Paleontological Area, and McCullough Peaks South Paleontological Area ACECs.
ACEC Area of Critical Environmental Concern

4.7.1.2 Analysis of Alternatives

Impacts Common to All Alternatives

Although the values of concern vary by area and ACEC, the effects of key management (i.e., ROWs, CTTM, VRM, and mineral development) on these values and other resource uses would have some similarities. The following paragraphs describe the general effects of key management.

Restrictions on the exploration for or development of mineral resources in an area designated as an ACEC would generally result in adverse impacts to minerals. Withdrawing or closing an area designated

as an ACEC to mineral or oil and gas development removes the potential to develop that resource. NSO, CSU, and TLS restrictions and limitations, or restrictions on surface-disturbing activities in ACECs can limit potential development, increase timeframes and costs, and may decrease the feasibility of economic recovery of mineral resources. Within an area designated as an ACEC, the BLM would require a plan of operations for all locatable mineral exploration (except casual use) and development, including disturbances of 5 acres or less (43 CFR 3809). The BLM would not automatically require a plan of operations absent such a designation (see Section 4.2.1 *Locatable Minerals* for more information). In parts of ACECs with low development or potential, the adverse impacts of such restrictions and stipulations generally would be lower because the resource is either not present in commercial quantities or is uneconomical to mine.

Closing an area to mineral development or applying other restrictions or mitigation to minerals development generally results in beneficial impacts to scenic quality, vegetation, soils, wildlife habitat, cultural resources, and other values of concern in ACECs by protecting the identified important and relevant resources from disturbance or degradation.

Impacts from ROW management in ACECs and other Management Areas generally affects the ROW program and the values of concern for the ACEC. Managing an area with more ROW restrictions, such as ROW avoidance/mitigation areas, generally would require additional mitigation, application of BMPs, or other design considerations that would result in adverse impacts to ROWs in the form of additional expense and delay of project development. Restrictions, limitations, or required mitigation for ROW authorizations generally result in beneficial impacts to the values of concern in ACECs by protecting these resources from disturbance or mitigating adverse impacts to an acceptable level.

Under all alternatives, management that restricts travel would result in adverse impacts to access and OHV use. Managing an area as limited to designated roads and trails, for example, would limit the roads and trails available for use and may adversely affect the ability to access certain areas. Restrictive travel management designations benefit values of concern for the ACEC by, for example, closing a route that may damage resources or limiting disturbances to wildlife in crucial winter ranges.

Any resource use that results in authorized or unauthorized road or trail development (e.g., oil and gas development or user-pioneered trails) can have a direct impact on paleontological resources, wildlife habitat, and other resource values because the road or trail may physically pass through or over these resources and damage or destroy them. In addition, an indirect impact from road and trail development may occur when the road provides access to a previously remote and/or inaccessible location. People who gain access may inadvertently damage fragile resources or disrupt wildlife during sensitive life stages.

Managing an area with more restrictive VRM classifications (Classes I and II) would result in adverse impacts to BLM-authorized actions that create surface disturbance or contrast with the visual setting. Adverse impacts to these BLM-authorized actions in areas with restrictive VRM classifications would result from changes to the size, scope, location, required mitigation, or BMPs for the actions. Managing an area with more restrictive VRM classifications would generally result in beneficial impacts to the important and relevant resources in an ACEC. Requiring additional design consideration and mitigation to preserve the visual setting in the area reduces the potential for facilities or development that could adversely affect important and relevant resources. Conversely, managing areas with less restrictive VRM classifications (Classes III and IV) would generally result in adverse impacts to values of concern, especially if the values of concern in an ACEC are associated with scenic quality.

Existing ACECs (No Expansion Proposed)

Big Cedar Ridge

Under alternatives A, B, and D, the BLM would manage the Big Cedar Ridge area (264 acres) as an ACEC; the BLM would not manage it as an ACEC under Alternative C. Paleontological resources (in the form of paleobotanical fossils of late Cretaceous age) are the values of concern in the Big Cedar Ridge area. Threats to the values of concern in this area include potential surface disturbance from mineral and ROW development, and theft and vandalism of paleontological resources.

4.7.1.3 Summary of Impacts by Alternative

Management under alternatives A, B, and D would be the most effective for protecting the paleontological values of concern in the Big Cedar Ridge area, but also would result in the greatest restrictions on ROW authorizations and mineral development in the area. Alternative C would be less effective for protecting the values of concern, but would be more beneficial to ROWs and other surface-disturbing activities than alternatives A, B, and D.

4.7.1.4 Detailed Analysis of Alternatives

Alternative A

Under Alternative A, Big Cedar Ridge area is an ACEC with management objectives designed to protect and maintain paleontological resources and provide hands-on educational experiences for visitors and groups.

Under Alternative A, restrictions on mineral development would result in adverse impacts to the use of these resources in the ACEC. The low potential for most mineral resources in the ACEC minimizes the adverse impacts of these restrictions on mineral development. Restrictions on mineral development would benefit the paleontological value of concern in the ACEC.

The ACEC is withdrawn from appropriation under the mining laws and the fossil concentration area (260 acres) is closed to mineral materials disposal. Withdrawing the ACEC would result in adverse impacts to locatable mineral development in the ACEC by prohibiting development of these minerals. However, the likelihood of adverse impacts is limited because the low potential in the ACEC for bentonite and gypsum (the only locatable minerals currently extracted in commercial quantities in the Planning Area) and sand and gravel. Withdrawing the Big Cedar Ridge ACEC would benefit paleontological resources by reducing the potential for destruction or degradation of these resources.

Alternative A manages the ACEC as open to mineral leasing with an NSO restriction and a prohibition of surface disturbance from geothermal exploration and development. Allowing mineral leasing with an NSO restriction may result in adverse impacts to mineral leasing in the ACEC by requiring directional drilling or other development techniques that may limit economically feasible recovery of these resources. NSO restrictions would benefit the values in the ACEC by reducing the potential for destruction or degradation of paleontological resources. However, the low development potential for oil and gas and the historically limited interest in such development in this area may minimize impacts to and from oil and gas development.

Managing the ACEC an ROW exclusion area, closing it to the use of heavy equipment, and limiting motorized vehicle use to existing roads and trails would result in adverse impacts to these resource uses in the ACEC. Restrictions on these resource uses would benefit paleontological resources in the ACEC by

preventing direct disturbance to these resources and by limiting the potential for indirect impacts from theft and vandalism, which increases with accessibility.

Management that allows the collection of fossils and provides educational research opportunities (including working with museums), while also protecting the resource, would result in beneficial impacts by protecting and promoting the paleontological values of the area. Allowing the use of hand tools in the ACEC to collect plant fossils for research and casual use in the fossil concentration areas, and only allowing mechanized collection on a case-by-case basis pending approval, would further increase benefits to paleontological values associated with research and would limit the use of heavy equipment or other excavation methods that could destroy or degrade resources.

Site-specific surveys for cultural and historic resources for casual use collection of plant fossils are not required. Because only casual use collection and use of hand tools are allowed for collection of fossils, these activities would not be likely to result in the destruction of cultural or historic resources if they are discovered.

Providing a focus area for recreational collection would benefit recreation in the Planning Area by allowing opportunities for legal recreational collection of common fossils. Recreational collection may result in long-term adverse impacts to paleontological resources in the ACEC because these resources would be lost to scientific and educational public uses.

Alternative B

The management of and impacts from designating the Big Cedar Ridge ACEC under Alternative B are the same as under Alternative A.

Alternative C

Under Alternative C, the BLM would not manage the Big Cedar Ridge area as an ACEC, but would manage it in accordance with multiple use principles consistent with other resource objectives and standard guidelines related to surface-disturbing activities would apply.

Under Alternative C, the area is open to locatable mineral entry, open to mineral leasing (with moderate constraints on 214 acres and standard stipulations on the remainder), and open to mineral materials disposal. Management of this area under Alternative C would be the least restrictive to mineral development, and may result in the greatest adverse impact to the paleontological values of concern.

Under Alternative C, the BLM would manage the Big Cedar Ridge area primarily as an ROW avoidance/mitigation area (223 acres), and would manage the remaining area as open to ROW authorizations. ROWs are allowed under this alternative, which would result in an increased potential for damage to known paleontological resources compared to the other alternatives.

Motorized vehicle use is limited to existing roads and trails under this alternative, and impacts from travel management would be the same as under Alternative A.

Applicable laws and regulations and the management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative C. These decisions include protective management, such as surveying and monitoring requirements in PFYC 5 formations, but generally would provide less protection for the paleontological values of concern than the other alternatives.

Alternative D

The management of and impacts from designating the Big Cedar Ridge ACEC under Alternative D are the same as under Alternative A.

Red Gulch Dinosaur Tracksite

Under alternatives A, B, and D, the BLM would manage the Red Gulch Dinosaur Tracksite area as an ACEC (1,798 acres); the BLM would not manage the area as an ACEC under Alternative C. Paleontological resources (in the form of trace fossils of early Jurassic age) are the values of concern in the Red Gulch Dinosaur Tracksite ACEC. Threats to the values of concern in this area include surface disturbance from mineral and ROW development, and theft and vandalism.

4.7.1.5 Summary of Impacts by Alternative

Management of the Red Gulch Dinosaur Tracksite ACEC under alternatives A, B, and D would be the most effective for protecting the paleontological values of concern, and these alternatives would result in minimal impacts to ROW and minerals development in the area. Alternative C, which does not designate the Red Gulch Dinosaur Tracksite as an ACEC, may result in adverse impacts to the paleontological values of concern. Management under Alternative C would be more beneficial to ROWs and other surface-disturbing activities than alternatives A, B, and D.

4.7.1.6 Detailed Analysis of Alternatives

Alternative A

Under Alternative A, management objectives in the Red Gulch Dinosaur Tracksite ACEC strive to protect and maintain the paleontological resources, including the largest dinosaur tracksite in Wyoming and other Middle Jurassic fossil deposits.

Surface-disturbing activities are prohibited in the ACEC, except for the construction of roads, trails, interpretive signs, and other facilities to enhance public education and recreation and activities allowed under a paleontological resources use permit.

Prohibiting or restricting surface-disturbing activities in the ACEC would result in adverse impacts to ROWs, renewable energy, and other types of development. Restrictions on surface-disturbing activities would benefit the paleontological value of concern for the ACEC by reducing the potential for destruction or degradation of paleontological resources and values. Under Alternative A, restrictions on mineral development would result in adverse impacts to the use of these resources in the ACEC. Under Alternative A, withdrawing the Red Gulch Dinosaur Tracksite ACEC from appropriation under the mining laws and managing it as open to mineral leasing with an NSO restriction in the Sundance Formation would result in adverse impacts to mineral resources. Withdrawing the ACEC would cause adverse impacts to locatable mineral development in the ACEC by prohibiting extraction of these minerals, particularly where the potential for gypsum is high. Withdrawal would eliminate the potential to develop this mineral because no new claims could be staked; valid existing mining claims represent valid existing rights and would not be affected by the withdrawal (see Section 4.2.1 *Locatable Minerals*). The development potential for oil and gas in the ACEC is very low and impacts from the restrictions on mineral leasing would be limited. Due to the low potential for sand and gravel across the entire ACEC, impacts to mineral materials disposal from restricting surface-disturbing activities in the ACEC would be limited. Withdrawals and closures to mineral development in the Red Gulch Dinosaur Tracksite ACEC

would reduce the potential for destruction or degradation of paleontological values, resulting in beneficial impacts.

Management actions restricting travel and setting permitting requirements would result in adverse impacts to these resource uses by limiting these activities in the ACEC. Restrictions on these resource uses would result in additional protection of and benefits to the paleontological values of concern in the ACEC. Limiting motorized vehicle use to designated roads and trails would restrict access in the area by limiting the roads available for travel. Motorized vehicle restrictions may benefit paleontological resources by reducing the potential for vehicle-caused damage to near-surface paleontological resources, such as dinosaur tracks. All scientific and educational researchers studying the dinosaur tracks or working in that geologic horizon in the Red Gulch Dinosaur Tracksite ACEC are required to obtain a paleontological resources use permit. Permit requirements would protect the integrity of the resources and enable the advancement of scientific knowledge by allowing excavations to continue.

Closing the interpretive area of the Red Gulch Dinosaur Tracksite ACEC to livestock grazing would not affect AUMs, but may provide additional protection for near surface paleontological resources that may be damaged by the passage of livestock.

Prohibiting the use of heavy equipment and chemical and dye retardants may adversely affect the ability to control wildland fires in the area. Reducing surface disturbance and the application of chemicals that may damage exposed dinosaur tracks would be beneficial to the protection of these resources. However, reducing available suppression tactics for wildland fire may increase its area and severity, which may damage paleontological resources close to the surface.

Alternative B

The management of and impacts from the Red Gulch Dinosaur Tracksite ACEC under Alternative B are the same as under Alternative A.

Alternative C

Under Alternative C, the BLM would not manage the Red Gulch Dinosaur Tracksite area as an ACEC, but would manage it in accordance with multiple use principles consistent with other resource objectives.

Under Alternative C, the area is open to locatable mineral entry, mineral leasing, and mineral materials disposal. There would be moderate constraints on oil and gas development in a portion of the area (1,674 acres), and the remainder of the area would be open to mineral leasing subject to standard lease stipulations. Alternative C includes the fewest restrictions on mineral development and would result in the smallest impact on the development of these resources. This management would result in the greatest adverse impacts to the paleontological values of concern compared to the other alternatives.

Managing the area under Alternative C would result in more surface disturbance that alternatives A and B. Under Alternative C, the BLM would manage the Red Gulch Dinosaur Tracksite area primarily as an ROW avoidance/mitigation area (1,674 acres) or open to ROW authorizations, although standard guidelines for surface disturbance would apply. Alternative C would allow for more potential ROW development in the area compared to the other alternatives, which would result in the greatest potential for damage to near-surface paleontological resources.

Alternative C limits motorized vehicle use to designated roads and trails; impacts from travel would be the same as under alternatives A and B.

Applicable laws and regulations and the management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative C. These decisions include protective

management, such as surveying and monitoring requirements in PFYC 5 formations, but generally would provide less protection for the paleontological values of concern than the other alternatives.

Alternative D

The management of and impacts from the Red Gulch Dinosaur Tracksite ACEC under Alternative D are the same as under Alternative A.

Sheep Mountain Anticline

Under alternatives A, B, and D, the BLM would designate the Sheep Mountain Anticline area an ACEC (11,528 acres), and would not designate it as an ACEC under Alternative C. The values of concern in the Sheep Mountain Anticline ACEC are geologic features, caves, cultural resources, and scenic qualities. The primary feature of the area is its classic Laramide anticline. Threats to the resource values in this area include surface disturbance from mineral and ROW development.

4.7.1.7 Summary of Impacts by Alternative

Alternatives A, B, and D would be the most effective for protecting the values of concern in the Sheep Mountain Anticline area because they would restrict locatable mineral development and prohibit surface-disturbing activities above caves and cave passages. Restrictions that limit surface disturbance, particularly under Alternative D, would reduce the potential for the disturbance of cultural resources and adverse impacts to the geology and associated scenic qualities of the area. However, these alternatives also would result in the greatest restrictions to mineral development and other surface-disturbing activities, particularly alternatives B and D, which, respectively, either make the ACEC administratively unavailable to mineral leasing or impose NSO/CSU stipulations. Alternative C would be least effective for protecting the values of concern, but would be more beneficial for mineral development and other activities that result in surface disturbance.

4.7.1.8 Detailed Analysis of Alternatives

Alternative A

Under Alternative A, the BLM would manage the Sheep Mountain Anticline to protect its geologic features and its recreational and interpretive uses. Management for the area is designed to protect the outstanding scenic values while continuing to provide limited developed recreational facilities and motorized access.

Under Alternative A, restrictions on mineral development would result in adverse impacts to these resource uses in the ACEC. The limited development potential for mineral resources in the ACEC would minimize the adverse impacts of these restrictions on mineral development. Restrictions on minerals development would benefit the values of concern by reducing the potential degradation of resources and the development of facilities and infrastructure that would impact scenic values.

Under Alternative A, the BLM withdraws the Sheep Mountain Anticline ACEC from appropriation under the mining laws and requires a plan of operations for existing mining claims for all locatable mineral exploration (except casual use). Withdrawing the ACEC would result in adverse impacts to locatable mineral development in the ACEC by prohibiting development of these minerals—no new claims could be staked—particularly where the potential is high for gypsum (2,649 acres) and bentonite (267 acres). Valid existing mining claims represent valid existing rights and would not be affected by the withdrawal (see Section 4.2.1 *Locatable Minerals*).

Under Alternative A, the Sheep Mountain Anticline ACEC is open to oil and gas leasing with primarily major and moderate constraints; however, the low development potential for oil and gas resources in this area limits impacts to oil and gas development and, conversely, limits development that may impact the values of concern in the ACEC.

Under Alternative A, prohibiting surface-disturbing activities such as geophysical exploration (except casual use), mineral materials disposal, and construction activities (except those related to development of recreation facilities or wildlife habitat) above caves and cave passages would result in adverse impacts to these resource uses by limiting these activities in the ACEC. Surface-disturbing activities elsewhere in the ACEC would be allowed, subject to restrictions on such activities addressed under other resources. The low potential for sand and gravel in most of the ACEC would limit adverse impacts to mineral materials disposal. The low potential for sand and gravel also would limit mineral material extraction and associated adverse impacts to cave and geologic values.

Limiting motorized travel in the ACEC to designated roads and trails and managing the area for the existing semi-primitive motorized and primitive recreational settings would result in adverse impacts to motorized vehicle use. Limiting motorized travel to designated roads and trails would reduce the available routes. These restrictions would maintain or enhance the recreational settings by eliminating unnecessary or undesirable vehicle routes, increasing opportunities for nonmotorized use, and allowing the closure of routes that result in adverse impacts to the values of concern.

Alternative B

With the exception of oil and gas leasing, management and impacts under Alternative B are the same as those under Alternative A.

Under Alternative B, making the ACEC administratively unavailable to oil and gas leasing would result in greater adverse impacts to the development of these resources than under Alternative A. The low development potential for oil and gas in the ACEC (ranging from low on 4,387 acres to very low on 7,141 acres on the remainder) would minimize these adverse impacts. Making the ACEC administratively unavailable to oil and gas leasing would provide the most protection to the values of concern of any alternative.

Alternative C

Alternative C does not designate the Sheep Mountain Anticline as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

The area is open to locatable mineral entry (except 172 acres), mineral leasing, and mineral materials disposal under Alternative C. There are moderate (7,790 acres) or major (3,446 acres) constraints on oil and gas development in most of the area, with these activities subject to standard restrictions in the remainder. Minerals management under Alternative C may result in greater development of these resources and therefore greater adverse impacts to the values of concern, compared to the other alternatives.

Alternative C limits motorized vehicle use to designated roads and trails; impacts from travel would be the same as alternatives A and B.

Alternative D

Except for oil and gas leasing, restrictions on surface-disturbing activities, and VRM, management and impacts under Alternative D would be the same as under Alternative A.

Under Alternative D, the BLM applies an NSO restriction on most of the ACEC and a CSU on the remainder. The effects of this management would result in greater adverse impacts to the development of leasable minerals than Alternative A, but these adverse impacts would be minimized because of the low to very low development potential for oil and gas in the area. The restrictions on leasable minerals would provide greater protection to the values of concern than alternatives A and C, but less than Alternative B.

Under Alternative D, the BLM would manage the Sheep Mountain Anticline ACEC as VRM Class II. Although none of the other alternatives includes specific VRM for this ACEC, the area is VRM Class II under alternatives B and C and VRM Classes III and IV (5,123 acres) under Alternative A, due to other resource considerations. Management as VRM Class II would require changes to the design and mitigation of BLM-authorized actions that would result in adverse impacts in the form of additional costs and delay for discretionary projects in the ACEC. Conversely, this VRM would benefit the values of concern, particularly the scenic qualities, by reducing or mitigating the visual contrast of BLM-authorized actions.

Alternative D imposes more restrictions on surface-disturbing activities than alternatives A and B. In addition to surface disturbance restrictions over cave and cave passage, this alternative only approves surface-disturbing activities elsewhere in the ACEC if the effects can be mitigated. Such a requirement would benefit geologic and related scenic values of concern for the area by limiting alterations to the visual environment, but may result in additional delay or expense for range improvements, ROW authorizations, and other surface-disturbing activities.

Spanish Point Karst

This area would be designated an ACEC under all the alternatives (6,627 acres). The values of concern managed for in the Spanish Point Karst ACEC are caves, recreational opportunities, sinking stream segments, an important aquifer recharge area, and important water quality functions. Threats to this ACEC include surface disturbance from mineral and ROW development and aerial spraying of pesticides onto aquifer recharge areas. Management and impacts to the area are the same under all alternatives.

4.7.1.9 Summary of Impacts by Alternative

The Spanish Point Karst area would be designated an ACEC with the same management under all alternatives, and impacts to the ACEC would be the same under all alternatives. Restrictions on resource uses in the ACEC would provide a beneficial impact to and protect the cave and karst system, important aquifer recharge zone, sinking stream segments, and the groundwater quantity and quality values of concern, but would result in adverse impacts to the restricted resource uses.

4.7.1.10 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

The management objective for the Spanish Point Karst area is the protection of the cave and karst system, important aquifer recharge zone, sinking stream segments, and the groundwater quantity and quality the area provides. Impacts from the management of the Spanish Point Karst area do not vary by alternative. Pursuing agreements for the cooperative management of surface activities in watersheds on USFS-administered and private lands in and adjacent to the Spanish Point Karst ACEC would result in beneficial impacts to the values of concern in the area by coordinating management for the protection of water resources. To the extent possible, the BLM also maintains compatible management prescriptions between these lands and those administered by the BLM.

Under Alternative A, restrictions on minerals development would result in adverse impacts to these resources in the ACEC. Restrictions on minerals development would benefit the values of concern by reducing potential activities that could degrade these values. Restrictions on minerals development include withdrawing the ACEC from appropriation under the mining laws, making it administratively unavailable to mineral leasing, and closing it to geophysical exploration. The potential for all mineral resources in the ACEC is low to very low, which minimizes adverse impacts to minerals development.

Managing the Spanish Point Karst ACEC as an ROW avoidance/mitigation area and closing it to motorized vehicle use would result in adverse impacts to these resource uses by limiting these activities in the ACEC. Restrictions on these resource uses would benefit caves, opportunities for primitive recreation, and water quality by minimizing surface disturbance and the potential for erosion and vegetation loss that would adversely affect these values.

Under all alternatives, managing basal vegetative cover to maximize (or maintain) ground cover in good or better ecological condition would benefit water quality by reducing erosion and the movement of sediment into water resources.

Existing ACECs (and Proposed Expansions)

Brown/Howe Dinosaur Area

This area would be designated an ACEC under all the alternatives, but the BLM would manage it within the existing boundaries under alternatives A, C, and D (5,517 acres) and expand it by 15,246 acres under Alternative B. Management of this ACEC would vary by alternative. The values of concern managed for in both the existing and expansion area of the Brown/Howe Dinosaur Area are paleontological resources, most notably dinosaur fossils from the suborder Theropoda and Sauropoda. Threats to the area proposed under alternatives A, C, and D include surface disturbance from mineral and ROW development, and theft and vandalism; threats to the area proposed for expansion under Alterative B do not include theft and vandalism.

4.7.1.11 Summary of Impacts by Alternative

Management under Alternative B would be the most effective for protecting the paleontological values of concern in the existing Brown/Howe Dinosaur Area ACEC and the proposed expansion area, but also would result in the greatest restrictions to the ROW authorizations and mineral development. Impacts under alternatives A, D, and C would be similar and would be less restrictive toward mineral resource development in the existing and expansion areas than under Alternative B. Management under alternatives A, D, and C would provide less protection for paleontological values compared to the expanded Brown/Howe Dinosaur Area ACEC under Alternative B.

4.7.1.12 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Under all alternatives, mitigating surface-disturbing activities in the Brown/Howe Dinosaur Area ACEC would benefit the protection the paleontological values of concern.

Prohibiting the sale or exchange of lands in the ACEC, unless such disposals are consistent with management objectives, would improve management effectiveness and efficiency and resource protection in the area. Allowing exchanges consistent with resource objectives (paleontological values)

would allow management flexibility to acquire high-value paleontological resources in the area while preventing land disposal that would transfer these resources out of BLM management.

Under all alternatives, limiting motorized vehicle use to designated roads and trails would reduce the routes available for recreational and other uses. Restrictions on motorized travel would decrease the potential for impacts to surface paleontological resources by allowing the closure of routes that result in adverse impacts to paleontological values.

All alternatives require fencing and signing of quarry sites in the Brown/Howe Dinosaur Area ACEC, which would benefit visitor safety and may reduce degradation of paleontological values from human disturbance.

All alternatives only allow fossil collection, excavation, or removal in the Brown/Howe Dinosaur Area ACEC under a permit issued by the Wyoming BLM State Director and only by institutions and individuals engaged in BLM-approved research, museum, or educational projects. These requirements would result in beneficial impacts by protecting the integrity of paleontological resources and enabling the advancement of scientific knowledge and research on these values in the area.

Alternative A

Allowing surface-disturbing activities in the ACEC, only if they are preceded by a paleontological sensitivity survey and monitored during construction, when necessary, would result in adverse impacts to ROW and minerals development and other surface-disturbing activities. The survey may delay activities or require mitigation or placement to limit impacts to paleontological values, but would continue to allow some activities while protecting the integrity of fossil-bearing material in the area. Restrictions on surface disturbance would benefit paleontological values of concern in the ACEC.

Managing the Brown/Howe Dinosaur Area ACEC as available for locatable mineral entry, open to mineral leasing, and open to mineral materials disposal would benefit these resource uses. Allowing mineral development would have an adverse impact on the paleontological values of concern in the ACEC. However, the low potential for development of these resources (BLM 1994c) would minimize the adverse and beneficial impacts of allowing locatable mineral entry. Requiring operations on oil and gas leases and mineral materials disposal to conform to the applicable provisions of the regulations (43 CFR 3100) and other terms and conditions determined necessary by the authorized officer to avoid damage to these resources would minimize adverse impacts to paleontological resources. Restrictions from the management of the ACEC and other resources result in major (2,196 acres) and moderate (3,163 acres) constraints on oil and gas development in this area.

Under Alternative A, the Brown/Howe Dinosaur Area ACEC is open to ROW authorizations, subject to the requirements for surface-disturbing activities described above, which would result in adverse impacts to paleontological resources in the ACEC. Requiring paleontological sensitivity surveys before approving minor ROW authorizations in the Brown/Howe Dinosaur Area ACEC may cause long-term adverse impacts to ROWs by increasing authorization processing times and potentially requiring mitigation, relocation, or modification of facilities if paleontological resources are found. Due to the small size of this area compared to the size of the Planning Area, these impacts may be minimal.

Alternative B

Under Alternative B, the BLM would expand the Brown/Howe Dinosaur Area ACEC by 15,246 acres. The management and impacts described under Impacts Common to All Alternatives and, unless otherwise noted, under Alternative A would apply to the expanded ACEC area. Expanding the ACEC would

increase restrictions on resource uses in the area and increase the protection of the paleontological values of concern in the area.

Under Alternative B, restrictions on mineral development in the expanded ACEC would result in greater adverse impacts to the use of these resources than under Alternative A. Restrictions on minerals development would result in greater beneficial impacts to paleontological values of concern compared to Alternative A.

The expanded ACEC is withdrawn from appropriation under the mining laws, administratively unavailable for mineral leasing, and closed to mineral materials disposal under Alternative B. Withdrawal from locatable mineral entry would result in adverse impacts to the use of mineral resources because no new claims could be staked; these impacts would be greatest in the approximately 1,462 acres of high-potential for bentonite and 3,079 acres of high-potential for gypsum in the expanded ACEC. The development potential within the Alternative A ACEC boundaries is low, which would limit the potential for adverse impacts to mineral development. The development potential for oil and gas in the ACEC is very low; therefore, adverse impacts to this resource use from the restrictions under Alternative B would be minimal. Adverse impacts from closing the area to mineral materials disposal would be greatest on the approximately 1,662 acres of high-potential for sand and gravel. Mineral restrictions, including the withdrawal, under Alternative B would result in greater beneficial impacts to paleontological resources in the area compared to alternatives A and C by decreasing mineral activity and associated disturbance that could degrade paleontological values. Decreased mineral activity also may reduce new roads and may decrease access opportunities for recreational collectors or access that could degrade resource values.

Under Alternative B, managing the ACEC as an ROW avoidance/mitigation area would result in greater adverse impacts to this resource use by limiting new ROW authorizations in the ACEC. Under Alternative A, the area proposed for expansion under Alternative B is open to ROW authorizations, subject to the standard requirements for surface-disturbing activities and paleontological resources. The more restrictive ROW management under Alternative B would reduce or mitigate surface disturbance and would provide more protection for paleontological resources than under Alternative A.

Alternative C

The management of and impacts from the Brown/Howe Dinosaur Area ACEC under Alternative C are the same as those under Alternative A.

Under Alternative C, the BLM would manage the area proposed for expansion under Alternative B primarily as an ROW avoidance/mitigation area (11,057 acres), with only a small portion (4,189 acres) open to ROW authorization. Therefore, ROW management is more restrictive than under Alternative A and impacts to the values of concern in this area would be similar to those under Alternative B.

Alternative D

The management of and impacts from the Brown/Howe Dinosaur Area ACEC under Alternative D are the same as those under Alternative A, except for surface-disturbing activities and VRM.

Similar to Alternative A, Alternative D allows surface-disturbing activities if preceded by an on-the-ground survey and monitoring. However, Alternative D may result in greater adverse impacts to paleontological values of concern because surveys and monitoring are only required in PFYC 3 through 5 formations on a case-by-case basis. Compared to the other alternatives, Alternative D may result in fewer adverse impacts to ROW placement and other surface-disturbing activities.

Under Alternative D, adverse impacts to locatable and leasable mineral uses and beneficial impacts to paleontological values of concern would be less than under Alternative B. Under Alternative D, the BLM manages the existing ACEC and the expansion area proposed under Alternative B as open to mineral materials disposal. Impacts would be the same as under alternatives A and C.

Under Alternative D, the BLM manages the Brown/Howe Dinosaur Area ACEC and the area proposed for expansion under Alternative B as ROW avoidance/mitigation areas. Impacts would be the same as under Alternative B.

Under Alternative D, the BLM manages the Brown/Howe Dinosaur Area ACEC and the area proposed for expansion under Alternative B as VRM Class III. Although none of the other alternatives includes specific VRM for this ACEC, managing it as VRM Class III would be more restrictive than VRM Class IV under Alternative C (14,588 acres) and less restrictive than VRM Class II under alternatives A and B (8,440 acres and 20,752 acres, respectively). Management as VRM Class III would allow BLM-authorized actions that result in surface-disturbing activities with reduced mitigation and siting restrictions, and related benefits to some resource uses and adverse impacts to paleontological resources, compared to VRM Class I and II areas.

Carter Mountain

The BLM would designate the Carter Mountain area as an ACEC under alternatives A and D (10,867 acres) and designate and expand it by 5,706 acres under Alternative B. The BLM would not designate the Carter Mountain area as an ACEC under Alternative C. Management of this area would vary by alternative. The values of concern in the Carter Mountain area are vegetation and wildlife resources, including alpine tundra and crucial winter range. Threats to this area include surface disturbance from mineral, ROW, and renewable energy development, and theft and vandalism. In addition, the proposed expansion area under Alternative B contains cultural features, recreational opportunities, special status species habitat, and fragile soils, and supports watershed functions. Threats to the Alternative B expansion area are the same as those to the ACEC under Alternative A, except that they do not include theft and vandalism.

4.7.1.13 Summary of Impacts by Alternative

Management under Alternative B would be the most effective for protecting the values of concern in the ACEC and expanded ACEC area. Alternative B also would result in the greatest restrictions on ROW authorizations, mineral development, and motorized vehicle use of any of the alternatives. Alternatives A and C would result in similar adverse and beneficial impacts. Alternative A includes more prohibitions for surface disturbance on slopes, and more restrictions on fire and fuels and recreation site development than Alternative C. However, the restrictions on motorized vehicle use and VRM classifications are more extensive under Alternative C. Both alternatives A and C would result in similar impacts to the development of mineral resources in the area.

4.7.1.14 Detailed Analysis of Alternatives

Alternative A

Prohibiting surface-disturbing activities on slopes of more than 7 percent would result in adverse impacts on the ability to construct range improvements, explore and develop certain minerals, authorize ROWs, and perform other activities. These restrictions would reduce surface-disturbing activities, which would benefit fragile soils, alpine tundra, crucial winter range, and the control of invasive species that

could degrade the vegetation and wildlife values of concern in the ACEC. Areas with steep slopes are particularly prone to erosion and can be difficult to reclaim following surface disturbance.

Managing the Carter Mountain ACEC as available for mineral entry, open to minerals leasing, and open to mineral materials disposal would result in adverse impacts to the values of concern by increasing the potential for surface-disturbing activities that could degrade soils and disturb vegetation and wildlife resources. The low potential for all the mineral resources in the ACEC would minimize adverse impacts to the values of concern. Managing the ACEC as primarily open to mineral development would benefit the use of these resources. There would be major constraints on oil and gas development across most of the ACEC (9,954 acres), with smaller areas of closure and moderate constraints across the remainder.

Acquiring 840 acres in the Carter Mountain ACEC under Alternative A would result in long-term beneficial impacts in the ACEC by improving the effectiveness and consistency of management for the area's watershed and habitat values through consolidation of land ownership.

Under Alternative A, managing the Carter Mountain ACEC as an ROW avoidance/mitigation area applies restrictions to ROW authorizations and would result in adverse impacts to ROW authorizations by limiting these authorizations or requiring specific lease stipulations. These restrictions would benefit the values of concern by reducing development and increasing impact mitigation measures. Requiring intensive mitigation for new ROWs would further benefit the values of concern by reducing the impacts of any new ROWs on vegetation, crucial winter range, and wildlife using the area.

Under Alternative A, limiting motorized vehicle use to designated roads and trails in the Carter Mountain ACEC, with a seasonal closure from November 15 to June 15 or later if weather or road conditions are unfavorable, would result in adverse impacts to motorized vehicle use. Adverse impacts to travel may be minimized because the BLM commits to maintaining existing public access and pursuing additional access opportunities under this alternative. Seasonal restrictions and limiting travel to designated roads and trails would benefit the values of concern by protecting fragile soils and alpine tundra and eliminating disturbances to big game habitat during sensitive periods. Requiring approval before snow is removed from BLM-administered roads in big game crucial winter range would further help minimize disturbance to wildlife.

Prohibiting the construction of new recreational sites and restricting the use of heavy equipment in the Carter Mountain ACEC would result in adverse impacts to recreation and fire and fuels management. Under this alternative, restrictions on recreational facility development may affect the BLM's ability to provide desired recreation experiences in the area. Heavy equipment restrictions may result in difficulties controlling or suppressing wildland fires in the ACEC, although the use of prescribed fire to control fuels is allowed. Restrictions on recreation and fire and fuels management would benefit the values of concern. These restrictions would prevent surface-disturbing activities that could affect wildlife and vegetation to protect fragile soils and alpine tundra.

Managing the Carter Mountain ACEC as VRM Class II would result in adverse impacts to resource uses by limiting certain activities in the ACEC. Activities such as range improvement projects and oil and gas facility development would be adversely affected because no activity would be allowed to attract the attention of the casual observer; therefore additional mitigation or design consideration may be required. Management as VRM Class II would benefit vegetation and wildlife habitat values of concern by limiting the size and types of development and surface disturbance that would be allowed, and potentially increasing mitigation for activities that did occur.

Alternative B

Under Alternative B, the BLM would expand the Carter Mountain ACEC by 5,706 acres. Management and impacts described for Alternative A, except for mineral and recreational facilities, would apply to the expanded area unless otherwise noted. The larger size of the expanded ACEC and the expansion of common management to include this area means that the impacts from such management would be comparatively larger under Alternative B than under Alternative A.

Under Alternative B, restrictions on mineral development would result in adverse impacts to the use of these resources. The ACEC is withdrawn from appropriation under the mining laws, administratively unavailable for mineral leasing, and closed to mineral materials disposal. The potential for gypsum and bentonite in the ACEC is low; therefore, adverse impacts to the use of these resources would be minimal. Managing the ACEC as administratively unavailable to oil and gas development would result in the greatest impact in the 1,780 acres with moderate development potential for oil and gas; the remainder of the ACEC has very low development potential. Likewise, closure to mineral materials would result in the greatest adverse impacts on the 1,872 acres with high-potential for sand and gravel in the ACEC. Minerals management under Alternative B is more restrictive than under Alternative A and would result in greater adverse impacts to mineral resources by further limiting development. Restrictions on minerals development would benefit the values of concern. Under Alternative A, the area proposed for expansion under Alternative B is available for locatable mineral entry and open to mineral leasing. Under Alternative B, more restrictive management limiting surface disturbance from minerals development would result in greater beneficial impacts, compared to Alternative A, in the existing and expansion areas on the vegetation, soils, big game crucial winter range, and cultural and recreational values of concern for these areas.

Managing the Carter Mountain ACEC expansion area as an ROW avoidance/mitigation area, limiting motorized vehicle use to designated roads and trails, and managing the area as VRM Class II would result in more restrictive management than under Alternative A. Under Alternative A, the area proposed for expansion under Alternative B is managed as an ROW avoidance/mitigation area. Under Alternative B, increasing resource use restrictions would result in greater adverse impacts to ROW authorizations, travel, and development activities compared to Alternative A. Managing the expansion area as VRM Class II places additional stipulations on the types and locations of activities that would be allowed in the ACEC compared to Alternative A. Under Alternative A, the BLM manages the area proposed for expansion under Alternative B as VRM Class IV (4,348 acres) or Class II (1,358 acres). Managing the existing and expansion areas as VRM Class II under Alternative B would maintain the visual environment more than Alternative A and provide the greatest benefits to recreational and other uses compared to the other alternatives.

Restricting travel to designated roads and trails in this area provides more protection than Alternative A for fragile soils, vegetation communities, wildlife habitat, watershed functions, and cultural resources. Under Alternative A, the BLM limits motorized vehicle use in the area proposed for expansion under Alternative B to existing roads and trails (5,135 acres), and limits the remainder to designated roads and trails (571 acres).

Alternative B allows the construction of recreational facilities to address visitor health and safety, use and user conflicts, and resource protection, which would result in greater beneficial impacts to recreational values than under Alternative A. This management may also increase surface disturbance and visitation to sensitive areas compared to Alternative A, which may result in adverse impacts to the non-recreational values of concern.

Alternative C

Under Alternative C, the BLM would not designate the Carter Mountain as an ACEC, and would manage it in accordance with multiple use principles consistent with other resource objectives.

Management under Alternative C would result in the least impact to the development of oil and gas resources and ROW authorizations. Similar to Alternative A, the area would be available for locatable mineral entry, open to mineral leasing, and open to mineral materials disposal. Constraints on oil and gas development would be lowest under this alternative, because there would be moderate constraints on oil and gas development on most of the area (15,563 acres), with major constraints on the remainder. Under Alternative C, the BLM would manage the Carter Mountain area as open to ROW authorizations. Standard guidelines related to surface disturbance would apply. These resource uses would result in additional surface disturbance in the area compared to alternatives A and B, leading to potential damage to the identified values of concern.

Applying only the standard guidelines for surface-disturbing activities under Alternative C would reduce the beneficial impacts on the protection of fragile soils, scenic quality, vegetation communities, wildlife habitat, watershed functions, and cultural resources compared to the other alternatives.

Managing motorized vehicle use as limited to designated roads and trails (5,135 acres) or with seasonal restrictions (11,438 acres) would result in impacts similar to those under Alternative A for the existing ACEC. Travel management in the proposed expansion area under alternatives B and D is more restrictive than under Alternative C and, therefore, Alternative C would result in fewer adverse impacts to travel. Compared to Alternative A, management of motorized vehicle use under Alternative C would result in fewer adverse impacts to the values of concern.

Under Alternative C, the BLM would manage the Carter Mountain area as VRM Class II, and impacts would be the similar to those under Alternative B.

Alternative D

Management of and impacts from the Carter Mountain ACEC under Alternative D are the same as under Alternative A, with the exceptions described below.

Management of and impacts to travel in the ACEC and the area proposed for expansion under Alternative D is the same as under Alternative B. Unlike alternatives A and B, this alternative does not pursue additional public access to the area, which may reduce the beneficial impacts to public access described for Alternative A.

In addition to the 840 acres identified for acquisition in Alternative A, Alternative D would consider the acquisition of other parcels from willing sellers in the Carter Mountain area. Such acquisitions may result in additional long-term beneficial impacts to management for the area's watershed and habitat values compared to Alternative A.

Under Alternative D, the BLM would manage ROW authorizations in the Carter Mountain ACEC and the expansion area proposed under Alternative B the same as under Alternative B. However, unlike alternatives A and B, intensive mitigation is not required for additional ROW authorizations, and associated adverse impacts to ROW authorizations and beneficial impacts to habitat and sensitive wildlife from this mitigation would not occur. Alternative D would allow surface-disturbing activities throughout the ACEC if the effects on alpine tundra could be avoided or mitigated based on site-specific analysis. Compared to alternatives A and B, allowing the construction of range improvements and other surface-disturbing activities throughout the ACEC would reduce adverse restrictions to these resource

uses and would reduce the benefits of prohibiting these activities in habitat and alpine tundra on steep slope.

Impacts from the construction of recreational facilities would the same as under Alternative B.

Under Alternative D, the management of mineral resources would generally be more restrictive than alternatives A and C, but less than Alternative B. Alternative D withdraws a smaller portion of the ACEC from locatable mineral entry (5,064 acres) than Alternative B, but, similar to Alternative B, the BLM would manage the entire area as administratively unavailable for oil and gas leasing. Similar to alternatives A and C, the entire area is available for mineral materials disposal.

VRM classifications and associated impacts in the Carter Mountain ACEC and the expansion area proposed under Alternative D are the same as under Alternative B.

Five Springs Falls

The BLM would designate the Five Springs Falls area as an ACEC under alternatives A and D (163 acres) and designate and expand it by 1,646 acres under Alternative B. The BLM would not designate the Five Springs Falls ACEC or its expansion area as an ACEC under Alternative C. Management of this area would vary by alternative. The values of concern in the Five Springs Falls ACEC include special status species plants and scenic and recreational features. In addition, the proposed expansion area contains geologic features and would be managed to improve public awareness of natural geologic hazards in the area. Threats in the area of the ACEC proposed under alternatives A and D include damage to rare and endemic plants caused by recreation. Threats to the expansion area proposed under Alternative B include surface disturbance from mineral and ROW development.

4.7.1.15 Summary of Impacts by Alternative

Management under Alternative B would be the most effective for protecting the special status plant species, scenic, recreational, and geologic values of concern within the ACEC boundary designated under alternatives A and D and the expanded ACEC designated under Alternative B. Alternative B also would result in the greatest restrictions on surface-disturbing activities and mineral development because the extent of the area to which this management is applied would be greater than under alternatives A and D. Alternative C would be less effective for protecting the values of concern in the ACEC and in the ACEC expansion area. Alternative C would be more beneficial than the other alternatives to ROW authorizations and other uses that require surface disturbance.

4.7.1.16 Detailed Analysis of Alternatives

Alternative A

Alternative A prohibits surface-disturbing activities such as geophysical exploration (except casual use) and construction activities (except those related to development of recreation or interpretive areas dealing with rare plants). Prohibiting surface-disturbing activities would result in adverse impacts by limiting these activities. This restriction would benefit special status plant species and scenic and recreational values of concern in the ACEC.

Withdrawing the ACEC from appropriations under the mining laws would result in minimal adverse impacts to locatable minerals because the potential for gypsum and bentonite is low in the ACEC. The Five Springs Falls ACEC is open to exploration and development of salable minerals and leasable minerals are open with an NSO restriction. However, there is no identified development potential for oil

and gas and there is low potential for sand and gravel within this ACEC. Therefore, impacts would be minimal for these minerals.

Under Alternative A, managing the Five Springs Falls ACEC as an ROW avoidance/mitigation area would result in adverse impacts to this resource use by limiting new ROW authorizations in the ACEC. ROW management would reduce or mitigate surface disturbance and would help protect scenic and recreational values of concern. Requiring intensive mitigation for new ROWs would further benefit these values by reducing the impacts of new ROWs.

Limiting motorized travel in the ACEC to designated roads and trails would result in adverse impacts to motorized vehicle use. This travel restriction would reduce the available routes and would allow the closure of routes that result in adverse impacts to the values of concern.

Under Alternative A, restricting the use of heavy equipment in the Five Springs Falls ACEC may result in adverse impacts to fire and fuels management by limiting the ability to effectively and efficiently control wildland fires in the ACEC. Restricting these surface-disturbing activities would result in beneficial impacts by limiting potential degradation or destruction of the values of concern. However, limiting available options to control the spread or severity of wildfire may result in more catastrophic wildfires.

Alternative B

Alternative B would expand the Five Springs Falls ACEC by 1,646 acres. Management and impacts described for Alternative A, with the exception of minerals, would apply to the expanded area unless otherwise noted. The larger size of the expanded ACEC, and the expansion of common management to include this area, would result in similar types of impacts to Alternative A, but to a greater extent.

Under Alternative B, restrictions on mineral development would result in adverse impacts to the use of these resources. Withdrawing the expansion area from appropriation under the mining laws would result in greater adverse impacts than Alternative A, particularly on the 1,646 acres of high-potential for bentonite. Valid existing mining claims represent valid existing rights and would not be affected by the withdrawal, although no new claims could be staked. This withdrawal would benefit the values of concern by reducing the impacts of surface disturbance. The degree of impacts from this withdrawal would be greater than under Alternative A, under which not withdrawing the area and allowing the staking of mining claims may result in adverse impacts to special status plant species habitat and scenic quality due to disturbance associated with mineral development. Making the ACEC administratively unavailable for mineral leasing and closing it to mineral materials disposal would result in minimal adverse impacts because the development potential for oil and gas ranges from low to none and the potential for sand and gravel is low. Both the adverse and beneficial impacts of these actions would be greater than for the existing area and the expansion area than under Alternative A, under which the BLM manages the area as open to mineral leasing and mineral materials disposal.

Managing the existing and expansion area of the Five Springs Falls ACEC as an ROW avoidance/mitigation area would result in greater adverse and beneficial impacts than under Alternative A, under which the expansion area is primarily open to ROW authorizations.

As under Alternative A, Alternative B limits motorized vehicle use in the existing and expansion area of the Five Springs Falls ACEC to designated roads and trails.

Alternative C

Under Alternative C, the BLM would not designate the area as an ACEC, and would manage it in accordance with multiple use principles consistent with other resource objectives.

Alternative C includes the least restrictions on mineral development because the area is available for locatable mineral entry, open to mineral leasing, and open for mineral materials disposal. Impacts to values of concern in the Five Springs Falls area from the development of minerals would be similar to those under Alternative A.

Management under this alternative would be the least restrictive for ROW authorizations because the area is primarily open to ROW authorizations and other surface-disturbing activities. Standard guidelines related to surface-disturbing activities would apply, but there would be more surface disturbance in the area compared to alternatives A and B, increasing the potential for damage to values of concern.

Under Alternative C, the BLM would limit motorized vehicle use to designated roads and trails (1,646 acres) or close some area to motorized travel (163 acres). Impacts from travel management would be the same as under the other alternatives.

Alternative D

Under Alternative D, management of and impacts from the Five Springs Falls ACEC would be the same as under Alternative A, with the exceptions identified below.

As under Alternative B, under Alternative D the BLM would close the existing Five Springs Falls ACEC to mineral materials disposal and make it administratively unavailable for mineral leasing under Alternative D. Therefore, impacts under Alternative D would be the same as under Alternative B in this area. Similar to Alternative C, the area proposed for expansion under Alternative B would be available for locatable mineral entry, primarily open to oil and gas leasing with moderate constraints (1,526 acres), and open to mineral materials disposal. Under Alternative D, impacts from the management of mineral exploration and development in the Alternative B expansion area would be similar to Alternative C.

As under Alternative B, under Alternative D the BLM would manage the existing Five Springs Falls ACEC and the expansion area proposed under Alternative B as an ROW avoidance/mitigation area. However, unlike Alternative B, intensive mitigation is not required for additional ROW authorizations. The additional adverse impacts to ROWs and additional benefits to special status plants species and scenic and recreational features from this additional mitigation would not occur under this alternative.

As under Alternative A, the existing area of the Five Springs Falls ACEC and the expansion area proposed under Alternative B are limited to designated roads and trails under Alternative D; impacts from this management would be the same as described under Alternative A.

Little Mountain

Under Alternative A, the BLM designates the Little Mountain area as an ACEC (21,475 acres) and designates and expands the area by 47,635 acres under Alternative B. The BLM would not designate these areas as ACECs under Alternative C. Under Alternative D, the BLM would designate the ACEC with the Alternative A boundaries, and would manage the area proposed for expansion under Alternative B as the Craig Thomas Little Mountain SMA. Although the Craig Thomas Little Mountain SMA exists and would continue under all the alternatives, the BLM does not apply special management in the area and proposes special management only under Alternative D. Management of this area would vary by alternative. Values of concern for this area includes caves, cultural and paleontological resources, and scenic qualities. In addition, the proposed expansion area contains wildlife and vegetation resources, including big game and special status species habitat and important plant populations. Threats to the ACEC and SMA include surface disturbance from mineral (including gravel pits, uranium, and limestone)

and ROW development, timber extraction, recreational and OHV use, and invasive species, which affect habitat for special status species and have the potential to disturb wintering wildlife.

4.7.1.17 Summary of Impacts by Alternative

Management under Alternative B would be the most effective for protecting the caves, cultural and paleontological resources, scenic, wildlife, and vegetation values of concern in both the alternatives A and D ACEC and alternatives B and D ACEC expansion or SMA boundaries because it allows the least development. Alternative B implements the greatest restrictions on surface-disturbing activities, mineral development, ROW authorizations, and motorized travel on the largest area, resulting in the greatest adverse impacts to these resource uses. Alternative D would result in impacts similar to Alternative B, although the adverse impacts to mineral leasing and locatable mineral entry and the beneficial impacts to the values of concern from restricting these mineral uses would both be less under Alternative D. Alternative C would be the least effective for protecting the values of concern in the ACEC area designated under alternatives A and D and the ACEC expansion or SMA areas proposed under alternatives B and D, respectively. Alternative C would be more beneficial to mineral development, ROW authorizations, and motorized travel than the other alternatives.

4.7.1.18 Detailed Analysis of Alternatives

Alternative A

Under Alternative A, the Little Mountain ACEC is available for locatable mineral entry, which would result in long-term adverse surface-disturbance impacts to the cultural, paleontological, and scenic values of concern for this area. As with all ACECs, the BLM has the ability to institute case-by-case withdrawals that may result in beneficial impacts to the values of concern by allowing for the protection of important sites. All cave and karst areas in the Planning Area also are withdrawn from appropriation under the mining laws, which would protect the Horsethief, Natural Trap, and other caves in the ACEC. Allowing locatable mineral entry would benefit this resource use, particularly where the potential for gypsum is moderate (3,154 acres).

Alternative A manages the ACEC as open to oil and gas leasing with an NSO restriction on the areas above these caves. Allowing mineral leasing with an NSO restriction would result in adverse impacts to mineral leasing in the ACEC by requiring directional drilling or other development techniques that may limit economically feasible recovery of these resources. NSO restrictions would benefit the values of concern in the ACEC by reducing their potential for destruction or degradation.

Under Alternative A, the Little Mountain ACEC is an ROW avoidance/mitigation area, which would result in adverse impacts to ROW authorizations. Managing the ACEC as an ROW avoidance/mitigation area and requiring intensive mitigation for new ROWs would benefit the values of concerns by reducing the impact of new ROWs on caves, cultural and paleontological resources, and scenic quality values of concern.

Under Alternative A, limiting motorized vehicle use to designated roads and trails would have adverse impacts on travel by limiting access and opportunities for travel. Travel management under Alternative A may result in beneficial impacts to the values of concern by eliminating routes that damage resources and limiting access to sensitive cultural, paleontological, and cave areas. Placing warnings signs around safety hazards in the Little Mountain ACEC to warn the public of health and safety hazards posed by radioactivity at uncovered mine entrances and adits would benefit visitor health and safety in the area.

Alternative B

Alternative B would expand the Little Mountain ACEC by 47,635 acres. Management and impacts described for Alternative A would apply to the expanded area unless otherwise noted. The larger size of the expanded ACEC, and the expansion of common management to include this area, would result in similar types of impacts, but to a greater extent than Alternative A.

Under Alternative B, restrictions on mineral development would result in adverse impacts to the use of these resources. The ACEC is withdrawn from appropriation under the mining laws and administratively unavailable for mineral leasing within the entire Little Mountain ACEC. Withdrawing the entire ACEC under Alternative B would have the greatest adverse impacts to locatable mineral development on the 16,867 acres with moderate-potential and the 745 acres with a high potential for gypsum. Withdrawal would eliminate the potential to develop locatable minerals because no new claims could be staked; valid existing mining claims represent valid existing rights and would not be affected by the withdrawal (see Section 4.2.1 *Locatable Minerals*). Adverse impacts to mineral development would be greater under Alternative B than under Alternative A, under which the BLM manages the expansion area as available for locatable mineral entry on 45,062 acres and would protect more area. Management of mineral leasing in the expansion area under Alternative B is more restrictive than under Alternative A. However, the development potential for oil and gas in the existing ACEC and expansion area ranges from very low to none, which may minimize the impact of this more restrictive management. Beneficial impacts to the values of concern as a result of restrictions on mineral development under Alternative B are greater than under Alternative A.

Managing the proposed ACEC expansion area as an ROW avoidance/mitigation area would result in greater adverse impacts to the authorization of ROWs because, unlike Alternative A, which manages a portion of the expansion areas as open to ROW authorizations (30,751 acres) and the remainder as an ROW avoidance/mitigation area, no areas would be open to ROWs. Managing the entire expansion area as an ROW avoidance/mitigation area would benefit the values of concern in the ACEC by limiting ROW development in the area or requiring mitigation to reduce adverse impacts.

Limiting motorized vehicle use in the ACEC to designated roads and trails would result in greater adverse impacts to motorized vehicle access and greater beneficial impacts to the values of concern than Alternative A in the Alternative B expansion area. Under Alternative A, the expansion area is limited to existing roads and trails.

Alternative C

Alternative C does not designate the Little Mountain area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

Similar to Alternative D, only a small portion of the area under Alternative C (488 acres) is withdrawn from appropriation under the mining laws. This management may result in greater adverse impacts to the values of concern in the Little Mountain area than alternatives A and B by increasing mineral activity and associated surface disturbance.

Management of ROWs and motorized vehicle use under Alternative C would be similar to that under Alternative A. Applying standard guidelines related to surface disturbance for ROWs would result in a lower standard for the mitigation of surface disturbance compared to alternatives A and B, leading to greater potential for adverse impacts to the values of concern under Alternative C than the other alternatives.

Alternative D

Under Alternative D, the management of and impacts from the Little Mountain ACEC and the Craig Thomas Little Mountain SMA are the same as under Alternative B, except for authorizations for renewable energy development, locatable mineral entry, and mineral leasing in the SMA.

Under Alternative D, the Craig Thomas Little Mountain SMA is a renewable energy exclusion area. Excluding renewable energy would result in adverse impacts to the development of wind energy in the Little Mountain area, but would reduce the possibility of damage to the values of concern from surface disturbance and prevent adverse impacts from the introduction of new contrasting elements, such as wind turbines, on scenic qualities. Management of renewable energy is more restrictive than the other alternatives, which primarily manage the area as an open or avoidance/mitigation area for renewable energy.

The Little Mountain ACEC and the Craig Thomas Little Mountain SMA would be available for locatable mineral entry. As noted for Alternative A, the BLM has the ability to institute withdrawals for ACECs on a case-by-case basis and withdraws cave and karst resources from appropriation under the mining laws. Allowing locatable mineral entry would benefit the development of these resources, particularly in the 16,867 acres with a moderate the 745 acres with a high potential for gypsum, and the 2,195 acres with a high potential for bentonite. Allowing locatable mineral entry would result in long-term adverse surface-disturbance impacts to the values of concern for this area, particularly cultural and paleontological resources, scenic qualities, and wildlife and special status species habitat.

Under Alternative D, the restrictions on mineral leasing in the Craig Thomas Little Mountain SMA would result in adverse impacts to the use of these resources, particularly on the 50,981 acres managed as administratively unavailable. Management of mineral leasing in the Craig Thomas Little Mountain SMA under Alternative D is more restrictive than under alternatives A and C, but less restrictive than under Alternative B. As noted for Alterative B, the very low to no development potential for oil and gas in this area may minimize the impact of restrictive management to mineral development. Conversely, beneficial impacts to the values of concern as a result of restrictions on mineral development would be greater than under alternatives A and C, but less than under Alternative B.

Upper Owl Creek Area

Alternative A designates the Upper Owl Creek area as an ACEC (13,057 acres); Alternative B designates and expands the ACEC by 19,720 acres to become the Upper Owl Creek/Absaroka Front ACEC. Alternative C would not designate the Upper Owl Creek area as an ACEC. Management of this area would vary by alternative. Values of concern in the Upper Owl Creek area include cultural sites, fisheries habitat, recreational opportunities, scenic qualities, shallow soils, special status species and wildlife habitat, and important vegetation communities. Threats to the values of concern in the ACEC proposed under Alternative A include surface disturbance from mineral and ROW development. In the expansion area proposed under Alternative B, threats to the values of concern also would include timber extraction and land disposals.

4.7.1.19 Summary of Impacts by Alternative

Alternative B would provide the greatest protection for the cultural sites, fisheries habitat, recreational opportunities, scenic qualities, shallow soils, special status species and wildlife habitat, and important vegetation communities that are the values of concern for the Upper Owl Creek area. Adverse impacts to the values of concern from travel management and surface disturbance would be greatest under Alternative C, but adverse impacts from ROW authorizations would be greater under alternatives A

and D. Alternative C generally would be the least restrictive to resource uses in the area, while Alternative B would include the most restrictions.

4.7.1.20 Detailed Analysis of Alternatives

Alternative A

Under Alternative A, limiting or prohibiting surface-disturbing activities in the Upper Owl Creek ACEC would restrict the ability to perform activities such as geophysical exploration and road construction. Restricting surface-disturbing activities would protect fragile soils, alpine tundra, important wildlife habitat, and scenic values of concern. Additional protection for these values would be provided by requiring a detailed activity plan before approval of any proposal for a major surface-disturbing activity.

Under Alternative A, restrictions on mineral development would result in minimal adverse impacts to these resources in the ACEC. Alternative A includes a withdrawal from appropriation under the mining laws for the Upper Owl Creek ACEC. The potential for gypsum and bentonite in the ACEC is low. Therefore, development and potential impacts would be low. The Upper Owl Creek ACEC is open to oil and gas leasing with an NSO restriction; however, the development potential for oil and gas in the ACEC is very low and there would be minimal adverse impacts from this management. Restrictions on minerals development would benefit the values of concern by reducing surface disturbance that could decrease the recreational setting, fragment or disturb special status species and wildlife habitat and vegetation communities, and reduce the potential for erosion and disturbance to shallow soils.

Managing the Upper Owl Creek ACEC as open for future ROW authorizations would result in adverse impacts to the values of concern by allowing development and disturbance associated with ROWs. There may be some impacts to fragile soils, vegetation, and wildlife habitat from ROW surface disturbance, although prohibiting and limiting surface-disturbing activities in this ACEC would minimize adverse impacts. Allowing ROW authorizations in this ACEC would benefit ROWs.

Restricting motorized travel to designated roads and trails would limit the roads and trails available for travel and would result in adverse impacts to travel and motorized recreational use. This designation may benefit the values of concern in the area by reducing the number roads and trails and closing routes that damage soils and vegetation; impact scenic quality; alter the desired primitive RSCC, experiences, and benefits; and impact wildlife habitat values of concern.

Encouraging coordination between the BLM and local stakeholders in landscape management may provide opportunities to improve wildlife habitat, decrease the fragmentation of vegetation communities, maintain or enhance the visual qualities, and provide for exceptional primitive type recreational opportunities, experiences, and benefits across jurisdictional boundaries within the mixed land ownership pattern of the ACEC.

Alternative B

Alternative B would expand the Upper Owl Creek ACEC by 19,720 acres and rename it the Upper Owl Creek/Absaroka Front ACEC. Management and impacts described for Alternative A would apply unless otherwise noted. The larger size of the expanded ACEC, and the expansion of common management to include this area, would result in similar, but comparatively greater impacts, to those under Alternative A.

Under Alternative B, expanding restrictions on mineral development would result in minimal adverse impacts to the use of these resources. The area withdrawn from appropriation under the mining laws is larger under Alternative B (13,238 acres). The proposed expansion area has low-potential for bentonite

and gypsum. Therefore, the withdrawal is expected to result in minimal adverse impacts to locatable mineral development in the area. In addition, making the ACEC administratively unavailable for oil and gas leasing would be more restrictive than under Alternative A, which manages the area as open, although the low to very low development potential for oil and gas in the area may minimize adverse impacts to mineral leasing. Management that restricts mineral development would benefit the values of concern by reducing the potential for surface disturbance associated with mineral development.

Expanding the ROW avoidance/mitigation area to include the expansion area would result in greater adverse impacts to the authorization of ROWs under Alternative B compared to Alternative A, which manages the expansion area as open to ROW authorizations. This management also would increase protection for the values of concern compared to the other alternatives.

Impacts to and from travel management would be similar to Alternative A, because most of the area under both alternatives is limited to designated roads and trails. Alternative A limits motorized vehicle use in the expansion area primarily to designated roads and trails (18,080 acres) with a smaller area limited to existing roads and trails (1,640 acres).

Alternative C

Alternative C does not designate the Upper Owl Creek area as an ACEC; the BLM would manage it in accordance with multiple use principles consistent with other resource objectives.

The area would be available for locatable mineral entry under Alternative C, but adverse and beneficial impacts would be minimal because the potential for gypsum and bentonite is low. Due to the low to no development potential for oil and gas in the area, impacts would be low and similar to Alternative A.

Alternative C manages the Upper Owl Creek area as open to ROW authorizations (29,743 acres) and as an ROW avoidance/mitigation area (3,034 acres). ROW management under Alternative C is more restrictive than under Alternative A, and the adverse impacts to ROW authorizations would be greater under Alternative C than under alternatives B and D. Beneficial impacts to the values of concern from ROW authorizations would be greater than under Alternative A due to increased area excluded and avoided to ROW authorizations. Only standard guidelines related to surface disturbance would apply, so the impacts from the additional restrictions on surface disturbance realized under alternatives A and B would not occur.

Under Alternative C, managing motorized vehicle use as limited to existing (19,720 acres) and limited to designated (13,057 acres) roads and trails would result in the greatest adverse impacts from motorized travel to the values of concern by increasing access and opportunities for travel that could degrade or damage resources. This alternative would place the fewest restrictions on motorized travel of any alternative.

Alternative D

Under Alternative D, management of and impacts from the Upper Owl Creek ACEC are the same as under Alternative A, except for ROW authorizations, locatable mineral entry, and mineral leasing. However, under Alternative D, management of the area proposed for expansion under Alternative B differs from management under Alternative A.

Under Alternative D, management to limit or prohibit surface-disturbing activities in the existing ACEC would result in impacts as described for Alterative A. In the proposed Alternative B expansion area, only standard guidelines related to surface disturbance would apply. Therefore, the impacts from the

additional restrictions on surface disturbance realized under Alternative B would not occur under Alternative D.

Unlike Alternative A, Alternative D manages the Upper Owl Creek ACEC as available for locatable mineral entry, administratively unavailable for oil and gas leasing, and as an ROW avoidance/mitigation area, which would result in adverse impacts to mineral leasing and ROW authorizations. Alternative D manages the area of the existing ACEC as administratively unavailable for oil and gas leasing and the area proposed for expansion under Alternative B as open with primarily moderate constraints (16,719 acres). This management would result in greater adverse impacts to mineral leasing and greater beneficial impacts to the values of concern than alternatives A and C, but less than Alternative B. Unlike alternatives A and C, this alternative does not withdraw the existing ACEC or the Alternative B expansion area, and impacts to and from locatable mineral entry would therefore be similar to Alternative C. However, as with all ACECs, the BLM has the ability to institute case-by-case withdrawals that may result in beneficial impacts to the values of concern in the existing ACEC by allowing for the protection of important sites.

Managing the existing ACEC as an ROW avoidance/mitigation area and open to ROW authorizations in the expansion area proposed under Alternative B would result in impacts to the authorization of ROWs and the values of concern similar to those for Alternative A, and fewer adverse impacts to ROW authorization and beneficial impacts to the values of concern than under Alternative B.

As under alternatives A and B, the existing area of the Upper Owl Creek ACEC and the expansion area proposed under Alternative B are limited to designated roads and trails under Alternative D. Impacts from this management would be the same as for the other alternatives.

Proposed ACECs

Chapman Bench

Alternative B would designate the Chapman Bench area as an ACEC (23,326 acres), but alternatives A and C would not. Although not proposed as an ACEC under Alternative D, the BLM manages a portion of this area as the Chapman Bench Management Area. Values of concern in the proposed Chapman Bench ACEC are special status bird species, vegetation, and wildlife habitat. Threats to this area include potential mining interests when this reserved land is opened to all public land laws, which would affect special status bird species (e.g., long billed curlew, mountain plover, and greater sage-grouse) in the area.

4.7.1.21 Summary of Impacts by Alternative

Alternative B is the only alternative that designates the Chapman Bench area as an ACEC and would be the most effective for protecting the special status bird species, vegetation, and wildlife habitat values of concern in the Chapman Bench area. Alternative B also would result in the greatest restrictions on the ROW authorizations, mineral leasing, and other surface-disturbing activities. Alternative D designates a portion of this area as the Chapman Bench Management Area and applies management to protect the values of concern; this management is less restrictive to resource uses and would provide fewer protections to special status species and wildlife habitat than Alternative B. Alternatives A and C would allow mineral development and would be less restrictive to ROW authorization than Alternative B. Alternative D would restrict locatable mineral entry, mineral materials disposal, and ROWs similar to Alternative B in the Chapman Bench ACEC, but would manage these activities similar to Alternative C across the remainder. Alternatives B and C would be the most restrictive of travel in the area, and

would therefore provide the greatest protection to values from fragmentation and disruption related to motorized vehicle use.

4.7.1.22 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the Chapman Bench area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

The Chapman Bench area has been closed to mineral entry because the BOR previously administered the land; Alternative A would open the area to mineral entry. Trace quantities of placer gold have been reported in stream sediment and gravel of Big Sand Coulee in the general area of Chapman Bench. Gold in the Big Sand Coulee area occurs as fine flakes and pin-point sized fragments (Thomas 1965). Managing the area as available for locatable mineral entry could result in adverse impacts to wildlife habitat if speculative placer gold claims were located in the area. The area has a low potential for gypsum and bentonite, which may minimize the potential for development and associated impacts to the values of concern. Under Alternative A, the area is open to mineral leasing with primarily moderate constraints, which could result in adverse impacts to the special status bird species, vegetation, and wildlife habitat values of concern due to surface disturbance and disruption. However, the development potential for oil and gas (9,206 acres of low potential and 14,121 acres very low potential) in the area may minimize the potential for development and associated impacts.

The area is open to mineral materials disposal, and adverse impacts to the values of concern would likely occur on the 5,852 acres where the potential for sand and gravel is high. Beneficial impacts to mineral development from this management would likely occur on this 5,852 acres by allowing disposal of mineral materials in this area, subject to BLM review.

The Chapman Bench area is managed primarily as open to ROW authorizations (18,668 acres), with a smaller area managed as a ROW avoidance/mitigation area (4,694 acres). Standard guidelines related to surface disturbance would apply. Allowing ROW authorizations would lead to surface disturbance and disruption and related adverse impacts to the values of concern, such as the spread of invasive species or the loss of vegetation. Managing the area as primarily open to ROW authorizations would benefit this resource use.

Alternative A manages motorized vehicle use in the Chapman Bench areas as limited to existing roads and trails, which would benefit motorized travel in the area. Travel management would benefit special status bird species, vegetation, and wildlife habitat by restricting off-road driving and damage to habitat or disruption of wildlife.

Alternative B

Under Alternative B, the BLM would manage the Chapman Bench area as an ACEC for the retention, enhancement, and success of the greater sage-grouse, mountain plover, and long-billed curlew. Prohibiting surface-disturbing activities in the Chapman Bench ACEC would restrict and result in adverse impacts to such activities as geophysical exploration and road construction. This restriction would benefit special status bird species and wildlife in the area by limiting the potential for disruptions, habitat fragmentation, or invasive species infestations that would degrade their habitat.

Under Alternative B, restrictions on mineral development would result in greater adverse impacts to these resource uses than under alternatives A or C. The ACEC is withdrawn from appropriation under the mining laws and administratively unavailable for mineral leasing; however, the potential for gypsum

and bentonite is low, and the development potential for oil and gas in the area consists of 9,206 acres of low potential and 14,121 acres of very low potential. Due to the low oil and gas development potential, development and resulting impacts would be minimal. The ACEC is closed to mineral materials disposal, and adverse impacts to mineral development would be greatest on the 5,852 acres with high-potential for sand and gravel. Impacts to mineral development would be greatest under Alternative B, because management is the most restrictive. Restrictions and closures of the area to mineral activity would benefit the values of concern in the ACEC by preventing mining-related surface disturbance, habitat fragmentation, and general degradation of the habitat and disturbance of special status species.

Under Alternative B, most of the Chapman Bench ACEC is a renewable energy and ROW avoidance/mitigation area (17,897 acres) and an ROW exclusion area on the remainder (5,430 acres). Of all the alternatives, this management is the most restrictive to future ROW authorizations and the most restrictive of ROW-related surface disturbance and disruption. This management would result in the greatest beneficial impacts to the wildlife and vegetation values of concern.

Alternative B limits motorized vehicle travel in the ACEC to existing roads and trails, and impacts under Alternative B would be the same as those under Alternative A.

Seasonally stipulating, where feasible, vegetative treatments, invasive, nonnative pest species control, fuels management, and maintenance of existing facilities in the Chapman Bench ACEC would protect wildlife and special status species during sensitive times of the year, while still allowing maintenance and treatments to occur.

Alternative C

Alternative C does not designate the Chapman Bench as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

The management of and impacts associated with mineral resources under Alternative C would be similar to those under Alternative A.

Alternative C manages the Chapman Bench area as an avoidance/mitigation area for ROW authorizations (19,664 acres), and manages a smaller area as open to ROW authorizations (3,662 acres). Management under this alternative would result in greater adverse impacts to ROW authorizations than under Alternative A because a larger portion is an ROW avoidance/mitigation area subject to development constraints or additional mitigation and monitoring that could affect construction costs. Such constraints would benefit special status bird species and wildlife that would be adversely affected by such developments. Standard guidelines related to surface disturbance would apply on portions managed as open to ROW authorizations.

Alternative C limits motorized vehicle use primarily to designated roads and trails (23,268 acres). This alternative is the most restrictive to motorized travel and would result in the greatest adverse impacts to travel and transportation management in the area. This alternative represents the smallest potential for travel-related impacts to the values of concern of any of the alternatives.

Alternative D

Under Alternative D, the BLM manages the Chapman Bench area as a Management Area for the retention and success of the greater sage-grouse, mountain plover, and long-billed curlew. The 3,425 acres of BLM-administered surface ownership managed for these values are all within the Alternative B ACEC (23,326 acres) boundaries. The BLM allows surface-disturbing activities across the entire Chapman Bench area, consistent with other resource objectives and standard guidelines for surface-disturbing

activities. The adverse and beneficial impacts of prohibiting such activities, as described for Alternative B, would not occur under this alternative.

The Chapman Bench Management Area is withdrawn from appropriation under the mining laws, open to mineral leasing with an NSO restriction, and closed to mineral materials disposal. The larger area proposed as an ACEC under Alternative B is open to locatable mineral entry, open to mineral leasing with moderate constraints, and open to mineral materials disposal. Impacts from the management of mineral uses in the Chapman Bench Management Area would result in adverse impacts to mineral exploration and development and benefits to the values of concern similar to Alternative B. In the larger area designated as an ACEC under Alternative B, impacts to and from mineral development under this alternative would be less beneficial to the values of concern and more beneficial to mineral development.

ROW management and associated impacts across the Chapman Bench area would be similar to those under Alternative C. Under Alternative D, the Chapman Bench Management Area is a renewable energy and ROW avoidance/mitigation area. The larger area designated as an ACEC under Alternative B generally is managed as an ROW avoidance/mitigation area, with a smaller area managed as open to ROW authorizations (3,691 acres).

Under Alternative D, management of and impacts from motorized vehicle use across the entire Chapman Bench area would be the same as under Alternative A.

Similar to Alternative B, under Alternative D the BLM can stipulate, where feasible, treatment and maintenance activities in the Chapman Bench Management Area to protect wildlife, while still allowing maintenance and treatments to occur. In the larger area proposed as an ACEC under Alternative B, the standard guidelines related to surface disturbance and the management of other resource objectives would apply to these activities; therefore, under Alternative D, impacts in this area would be similar to those under alternatives A and C.

Clarks Fork Basin/Polecat Bench West Paleontological Area

Alternative B would designate the Clarks Fork Basin/Polecat Bench West Paleontological Area as an ACEC (23,895 acres); alternatives A, C, and D would not. Although not proposed under Alternative D, a portion of this area falls within the proposed PETM ACEC. The values of concern in the proposed Clarks Fork Basin/Polecat Bench West Paleontological Area ACEC are paleontological resources in the form of mammalian and paleobotanical fossils and geochemical data used in the study of a major Carbon Isotope Excursion recorded during an ancient period of global warming known as the PETM. Scenic and geologic features also are valuable features in this ACEC. Threats to the area include additional surface disturbance from mineral development (e.g., oil and gas, mineral materials, and possible locatable mineral mining), and ROW development, timber extraction, recreational and OHV use, and invasive and nonnative species infestations. These activities threaten habitat for special status species and create disturbances in crucial winter range during sensitive periods. Heavy public recreational use and existing SRPs also threaten the values of concern in the area. Water quality and quantity issues, as a result of surface and groundwater withdrawals and untreated irrigation outflows, also threaten the area.

4.7.1.23 Summary of Impacts by Alternative

Alternative B is the only alternative that designates the Clarks Fork Basin/Polecat Bench West Paleontological area as an ACEC, and would be the most effective for protecting the paleontological values of concern. Alternative B also would be the most restrictive to surface-disturbing activities, mineral development, ROWs, and motorized travel. Alternative B includes specific requirements related

to paleontological sensitivity surveys and monitoring that would benefit the protection of the values of concern and would not exist under the other alternatives. The management of mineral development would be similar under alternatives A and C, but ROW and motorized travel management under Alternative C would be more restrictive than under Alternative A. A portion of the Clarks Fork Basin/Polecat Bench West Paleontological area is included in the PETM ACEC under Alternative D; the *Paleocene-Eocene Thermal Maximum* section describes management of and impacts to this area under Alternative D.

4.7.1.24 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry, open to mineral leasing (with primarily moderate constraints on 11,691 acres), and open to mineral materials disposal on 23,113 acres under Alternative A. A plan of operations would not be required for notice-level locatable minerals activities. The low potential for gypsum and bentonite, the low (23,320 acres) to very low (575 acres) development potential for oil and gas, and the low potential for sand and gravel in the area would result in fewer adverse impacts to minerals development activities.

Alternative A manages the Clarks Fork Basin/Polecat Bench West Paleontological Area as open to ROW authorizations (20,068 acres), and manages a smaller area as an ROW avoidance/mitigation area (3,271 acres). Standard guidelines related to surface disturbance would apply. ROW management would benefit this resource use in open areas, but may limit such development in avoidance/mitigation areas or require specific mitigation that may increase project costs and timeframes. Restrictions on ROW developments would generally benefit paleontological resources by reducing surface-disturbing activities and potential destruction of paleontological values.

Alternative A limits motorized vehicle use to existing roads and trails, which may result in adverse impacts to values of concern by allowing access to travel that may disturb and degrade paleontological values of concern in the area.

The Clarks Fork Basin/Polecat Bench West Paleontological Area is open to livestock grazing under Alternative A. Livestock trampling and wallowing in areas of concentrated livestock use can damage exposed paleontological resources. While in most instances, concentrated livestock use would result in adverse impacts to paleontological values, proper livestock grazing management can mitigate these impacts by improving the distribution of livestock.

Restricting surface disturbance solely through application of the standard guidelines for surface disturbance may lead to damage to the identified values of concern, soil erosion, spread of invasive species, and impacts to water quality. Management under this alternative would be the least restrictive of ROW authorizations and other surface-disturbing activities, and would result in the largest adverse impact to the identified values of concern.

Alternative B

Management of surface-disturbing activities in the ACEC emphasizes avoiding impairment of the management objectives and existing values, while protecting the integrity of fossil-bearing material. Under Alternative B, avoiding or prohibiting surface-disturbing activities and the use, occupation, construction, or maintenance of facilities in the Clarks Fork Basin/Polecat Bench West Paleontological

ACEC that are inconsistent with the management direction and objectives for the area would restrict development and maintenance activities, but would benefit the protection of paleontological resources. Requiring that minor ROW authorizations and other minor surface-disturbing activities be preceded by paleontological sensitivity surveys and potential monitoring during construction, may have long-term impacts by increasing processing times of authorizations and potentially requiring mitigation, relocation, or modification of facilities if paleontological resources are found. These ROW and surface-disturbance stipulations would further protect paleontological resources in the area.

Under Alternative B, withdrawing the Clarks Fork Basin/Polecat Bench West Paleontological ACEC from appropriation under the mining laws and closing the area to geophysical exploration would result in greater adverse impacts to mineral development than Alternative A. Restricting mineral development would benefit the ACEC by reducing the potential for destruction or degradation of paleontological values and the other adverse impacts associated with surface disturbance (e.g., the potential spread of invasive species).

Under Alternative B, the Clarks Fork Basin/Polecat Bench West Paleontological ACEC is a renewable energy exclusion area and motorized vehicle use is limited to designated roads and trails. Excluding renewable energy would result in adverse impacts to the ability to develop renewable energy. Limiting motorized vehicle use to designated roads and trails would restrict access in the area by limiting the roads available for recreational and other motorized travel. Restrictions on renewable energy and motorized travel would reduce the possibility of damage to paleontological resources from surface disturbance and would allow the closure of routes that may result in damage to paleontological resources. Management of travel and renewable energy is more restrictive under Alternative B than under Alternative A and resulting beneficial impacts for the values of concern would be greater under Alternative B.

Management under Alternative B continues livestock grazing provided it does not disturb the natural, educational, and scientific research values of the ACEC. The flexibility to restrict livestock grazing if use becomes concentrated or adversely affects other resource values may result in beneficial impacts to the values of concern by reducing potential degradation by livestock. Conversely, any restrictions could adversely affect livestock grazing by reducing the number of AUMs available in the ACEC from its current level of 1,344.

Fossil collection, excavation, or removal in the Clarks Fork Basin/Polecat Bench West Paleontological ACEC would be allowed under a permit issued by the Wyoming BLM State Director and only to institutions and individuals engaged in BLM-approved research, museum, or educational projects. This management would protect the integrity of the resources and enable the advancement of scientific knowledge in the area, but also would restrict recreational collection of fossils.

Alternative C

Alternative C does not designate the area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry and open to mineral leasing (with primarily moderate constraints on 14,951 acres), and primarily open to mineral materials disposal (20,543 acres). Impacts would be similar to those under Alternative A.

Alternative C manages the Clarks Fork Basin/Polecat Bench West Paleontological area as an avoidance/mitigation area for ROW authorizations (21,058 acres), and manages a smaller area managed as open to ROW (12,796 acres). Standard guidelines related to surface disturbance would apply, but the additional restrictions under Alternative B would not. As under Alternative B, Alternative C limits

motorized vehicle use to designated roads and trails. Management under Alternative C is more restrictive to ROW development and motorized travel than under Alternative A.

The standard guidelines related to surface disturbance would apply and may result in additional surface disturbance in the area compared to alternatives A or B, leading to potential soil erosion, spread of invasive species, impacts to water quality and damage to the identified values of concern. Management under Alternative C would be the least restrictive of ROW authorizations and other surface-disturbing activities and would result in the largest adverse impact on the identified values of concern.

Alternative D

Alternative D does not designate this area as an ACEC. Part of the Clarks Fork Basin/Polecat Bench West Paleontological area (4,972 acres) is within the proposed PETM ACEC. See the *Paleocene-Eocene Thermal Maximum* section for an analysis of the effects of management in this area.

Clarks Fork Canyon

The Clarks Fork Canyon area would be designated as an ACEC under alternatives B (12,259 acres) and D (2,724 acres); it would not be designated as an ACEC under alternatives A or C. The values of concern in the proposed Clarks Fork Canyon ACEC are geologic features, including the Canyon Mouth Anticline, and glacial features, open space, recreational opportunities, special status species plants and wildlife, and wildlife habitat. Threats to this proposed ACEC include surface disturbance from mineral and ROW development.

4.7.1.25 Summary of Impacts by Alternative

Alternatives B and D are the only alternatives that designate the Clarks Fork Canyon area as an ACEC. Due to the larger size and more restrictive management, Alternative B would be the most effective for protecting the glacial features, open space, recreational opportunities, special status species plants and wildlife, and wildlife habitat values of concern in the ACEC. Alternative B would be most effective for managing threats from motorized vehicle use and surface disturbance resulting from ROW development and locatable mineral entry by including the greatest restrictions on these activities. Management of mineral materials disposal and oil and gas leasing under alternatives B and D would be similar within their respective ACEC boundaries, although the larger area managed under Alternative B would be less restrictive under Alternative D. Alternative A generally would provide the least restrictive management and would be the least effective for protecting the values of concern. Alternative A would be the most beneficial to motorized travel and would include management for locatable and mineral materials similar to Alternative C. Alternative C would be the most beneficial to ROW authorizations.

4.7.1.26 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The area would be mostly open for locatable mineral entry with a withdrawal on 1,714 acres, open to mineral leasing (with primarily major constraints on 10,968 acres), and primarily open to mineral materials disposal (8,948 acres). Allowing mineral development would result in surface disturbance that would degrade wildlife and special status species habitat and may damage the glacial features and recreational setting values of the area.

The Clarks Fork Canyon area is managed as open to ROW authorizations on 5,399 acres and as an ROW avoidance/mitigation area on 5,740 acres. Managing a portion of the area as open to ROW authorizations would result in adverse impacts to the values of concern, including degradation of wildlife and special status species habitat and damage to glacial features and the recreational setting.

Alternative A limits motorized vehicle use to existing roads and trails (11,759 acres), and manages a small area with seasonal restrictions (500 acres).

Alternative B

Prohibiting surface-disturbing activities in the Clarks Fork Canyon ACEC would restrict and have an adverse impact on such activities as geophysical exploration and road construction. Restrictions on surface disturbance would benefit special status species plants and wildlife in the area by limiting the potential for disruptions, habitat fragmentation, or invasive species infestations that would degrade their habitat.

Restrictions on mineral development under Alternative B would result in greater adverse impacts to the use of these resources compared to the other alternatives. The ACEC is withdrawn from appropriation under the mining laws and administratively unavailable for mineral leasing. Adverse impacts from mineral withdrawal generally would be greatest in the approximately 596 acres with gypsum potential and 1,025 acres with bentonite potential, but because of the lack of commercial-grade resources, impacts to mineral development would be minimal. Adverse impacts to mineral materials disposal would be greatest on 4,293 acres with higher potential for sand and gravel. The very low development potential for oil and gas would minimize the potential for adverse impacts to leasable minerals development as a result of managing the area as administratively unavailable to leasing.

Alternative B manages the Clarks Fork Canyon ACEC as an ROW avoidance/mitigation area, a renewable energy exclusion area, and closed to motorized and mechanized vehicle use or limited to designated roads and trails. Adverse impacts to these resource uses would be greater under Alternative B than Alternative A because there would be more restrictions on use. More restrictive ROW management would reduce or mitigate surface disturbance and would result in greater protection for values of concern than under Alternative A. In addition, more restrictive motorized travel management would reduce disturbance to wildlife compared to Alternative A.

Allowing and seasonally stipulating vegetative treatments, invasive/nonnative pest species control, fuels management, and maintenance of existing facilities would protect wildlife and special status species during sensitive periods, while still allowing maintenance and treatments to occur.

Alternative C

Alternative C does not designate the Clarks Fork Canyon area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

Management of locatable minerals would be similar to Alternative A (withdrawn on 1,766 acres), and the area would be open to mineral leasing (with moderate constraints on 8,654 acres and major constraints on the 3,585 acres) and primarily open to mineral materials disposal (9,097 acres). Alternative C would be less restrictive to mineral development than Alternative A, and adverse impacts to the values of concern in the area may be greater under Alternative C.

Alternative C manages the Clarks Fork Canyon area as primarily open to ROW authorizations (10,890 acres), manages a smaller area for ROW avoidance/mitigation (1,369 acres), and applies standard guidelines related to surface-disturbing activities. Alternative C manages motorized vehicle use as

limited to designated roads and trails on 4,889 acres and under seasonal restrictions in the remaining 7,370 acres in the area. Alternative C is more restrictive to ROW and motorized travel management than Alternative A, but less restrictive than Alternative B. Under Alternative C, there would be more benefits to the values of concern than under Alternative A, but less than under Alternative B.

Alternative D

Allowing surface-disturbing activities in the Clarks Fork Canyon ACEC consistent with the goals of the ACEC would eliminate many of the beneficial impacts to special status species plants and wildlife, and the adverse impacts to surface-disturbing activities, predicted to result from the surface disturbance prohibition under Alternative B. However, because surface-disturbing activities would need to be consistent with the goals of the ACEC, this alternative may increase adverse impacts to resource uses and beneficial impacts to the values of concern compared to alternatives A and C, under which there would be standard restrictions on surface disturbance.

Under Alternative D, restrictions on mineral development would result in greater adverse impacts to the use of these resources than under alternatives A or C, but less than under Alternative B. Management of and impacts from the management of locatable minerals would be the same as under alternatives A and C. As with Alternative B, the ACEC is administratively unavailable for mineral leasing and closed to mineral materials disposal; however, similar to Alternative C, under Alternative D the additional area proposed under Alternative B is primarily managed as open to mineral leasing with moderate constraints (9,094 acres) and is open to mineral materials disposal. The very low development potential for oil and gas and low-potential for sand and gravel would minimize the potential for adverse impacts to mineral development in the administratively unavailable and closed portions of the Clarks Fork Canyon area.

Adverse impacts to renewable energy and ROWs and beneficial impacts to the values of concern would be similar to those under Alternative B across the Clarks Fork Canyon area.

Under Alternative D, management of and impacts from motorized travel in the area designated as an ACEC and the larger area proposed under Alternative B would be the same as under Alternative C.

Alternative D allows and seasonally stipulates vegetative treatments, invasive, nonnative pest species control, fuels management, and maintenance of existing facilities, resulting in the same impacts as Alternative B. However, these beneficial impacts would occur over a smaller area because these activities would be governed by other resource considerations in the additional area proposed under Alternative B.

Foster Gulch Paleontological Area

Alternative B would designate the Foster Gulch Paleontological Area as an ACEC (27,302 acres); the other alternatives would not. The values of concern in the proposed Foster Gulch Paleontological Area ACEC are paleontological resources in the form of mammalian and paleobotanical fossils and geochemical data used in the study of a major Carbon Isotope Excursion recorded during an ancient period of global warming known as the PETM. Scenic and geologic features also are valuable in this ACEC. Threats to this proposed ACEC include surface disturbance from mineral (primarily oil and gas) and ROW development.

4.7.1.27 Summary of Impacts by Alternative

Alternative B would be the most effective for protecting the paleontological and geological values of concern in the Foster Gulch Paleontological Area. This alternative also would result in the greatest

restrictions on mineral development, ROW authorizations, and other surface-disturbing activities; motorized travel; livestock grazing management; and the excavation of paleontological resources. Impacts under alternatives A and C would be similar and would allow mineral development, would open more routes to motorized travel, and would be less restrictive to the authorization of ROWs and surface disturbance in areas with paleontological resources. A portion of the Foster Gulch Paleontological Area is included in the PETM ACEC under Alternative D; the *Paleocene-Eocene Thermal Maximum* section describes management of and impacts to this area under Alternative D.

4.7.1.28 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry, open to mineral leasing (with primarily moderate constraints on 24,102 acres and major constraints on the remaining 3,200 acres), and open to mineral materials disposal. Mineral development is one of the threats to the paleontological and geological values of the area, and allowing this type of development with minimal restrictions would result in surface disturbance that would cause adverse impacts to values of concern. Except for a small area of high-potential for sand and gravel, low-potential for bentonite and gypsum and low to very low development potential for oil and gas may minimize adverse impacts to minerals development.

The Foster Gulch Paleontological Area is primarily open to ROW authorizations (24,541 acres), with the remainder managed as an ROW avoidance/mitigation area (2,761 acres). Managing this area as primarily open to ROW authorizations would result in adverse impacts to the values of concern associated with surface disturbance and ROW development. Managing most of the area as open to ROW authorizations would result in beneficial impacts to ROWs by allowing these authorizations in the area.

Alternative A limits motorized vehicle use to existing roads and trails in the area. Limiting motorized travel to existing roads and trails may benefit the values of concern in the ACEC by preventing open access that could degrade paleontological resources.

The Foster Gulch Paleontological Area is open to livestock grazing under Alternative A. Managing this area as open to livestock grazing could result in adverse impacts to paleontological resources that may be damaged by livestock trampling and wallowing in areas of concentrated livestock use. Proper management of livestock grazing can mitigate the impacts of grazing by improving the distribution of livestock.

Applicable laws and regulations and the management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative A. These decisions include protective management, such as surveying and monitoring surface-disturbing activities for PFYC 5 formations and PFYC 4 formations (on a case-by-case basis), that would provide some protection to the paleontological values.

Alternative B

Management for the ACEC under Alternative B is designed to reduce adverse impacts to paleontological and geological values of concern from surface disturbance. Management under this alternative requires avoiding or prohibiting surface-disturbing activities in the Foster Gulch Paleontological Area ACEC, and prohibiting the use, occupation, construction, or maintenance of facilities in the Foster Gulch

Paleontological Area ACEC that are inconsistent with the management direction and objectives for the area. Allowing minor surface-disturbing activities in the Foster Gulch Paleontological Area ACEC if they are preceded by a paleontological sensitivity survey and, if necessary, are monitored during construction, would help protect paleontological resources in the area. Restricting surface-disturbing activities could increase delay or expense, but would continue to allow some activities while also protecting the integrity of fossil-bearing material in the area.

Under Alternative B, withdrawing the Foster Gulch Paleontological Area ACEC from appropriation under the mining laws, managing the area as administratively unavailable to mineral leasing, and closing it to mineral materials disposal and geophysical exploration would result in greater adverse impacts to mineral development than under Alternative A. Restricting mineral development would result in greater beneficial impacts to the paleontological and geologic values in the area than Alternative A. The low potential for mineral resources in the area may minimize these impacts.

Alternative B is more restrictive than Alternative A in managing ROWs, motorized vehicle use, and livestock grazing; adverse impacts to these resource uses would be greater than under Alternative A. Alternative B manages the Foster Gulch Paleontological Area ACEC as an ROW and renewable energy avoidance/mitigation area, limits motorized vehicle use to designated roads and trails, and allows livestock grazing under existing regulations, provided it does not disturb the natural, educational, and scientific research values of the Foster Gulch Paleontological Area ACEC. This management would reduce the potential for surface disturbance and would provide increased flexibility to further restrict activities (such as livestock grazing and resource-degrading travel routes) determined to be adverse to the values of concern. Any restrictions on grazing could reduce the currently available 1,206 AUMs in the ACEC and adversely impact livestock grazing.

Alternative B allows fossil collection, excavation, or removal in the Foster Gulch Paleontological Area ACEC only under a permit issued by the Wyoming BLM State Director and only by institutions and individuals engaged in BLM-approved research, or museum and educational projects that provide for detailed recordation, reporting, care of specimens, and availability of specimens to other scientists and museums. Such requirements would result in beneficial impacts by protecting the integrity of the resources and enable the advancement of scientific knowledge.

Alternative C

Alternative C does not designate the area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

The management of and impacts associated with mineral development under Alternative C would be the same as under Alternative A.

Similar to Alternative A, Alternative C manages the Foster Gulch Paleontological Area as primarily open to ROW authorizations (25,621 acres), and manages a smaller area as an ROW avoidance/mitigation area (1,681 acres). ROW management would result in impacts to the values of concern similar to Alternative A.

Alternative C is more restrictive to motorized vehicle use than Alternative A (travel is limited to designated roads and trails on 17,591 acres and existing roads and trails on 9,711 acres), but less restrictive than Alternative B. Therefore, Alternative C would result in greater beneficial impacts to the values of concern more than Alternative A, but less than Alternative B.

Applicable laws and regulations and the management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative C. This management would be less

restrictive to surface disturbance than under Alternative A, because it does not require on-the-ground surveys for PFYC 4 formations on a case-by-case basis.

Alternative D

Alternative D does not designate this area an ACEC. Part of the Foster Gulch Paleontological area (4,974 acres) is within the proposed PETM ACEC. See the *Paleocene-Eocene Thermal Maximum* section for an analysis of the effects of management of this area.

McCullough Peaks South Paleontological Area

Alternative B designates the McCullough Peaks South Paleontological Area as an ACEC (6,994 acres); the other alternatives do not. The values of concern in the proposed McCullough Peaks South Paleontological Area ACEC are paleontological resources in the form of mammalian and paleobotanical fossils and geochemical data used in the study of a major Carbon Isotope Excursion recorded during an ancient period of global warming known as the PETM. Scenic and geologic features also are valuable in this ACEC. Threats to this proposed ACEC include surface disturbance from mineral (primarily oil and gas) and ROW development.

4.7.1.29 Summary of Impacts by Alternative

Alternative B would be the most effective for protecting the paleontological and geological values of concern in the McCullough Peaks South Paleontological Area. Alternative B also would result in the greatest restrictions on mineral development, ROW authorizations and other surface-disturbing activities; motorized travel; livestock grazing; and the excavation of paleontological resources. Alternatives A and C would allow mineral development, would open more routes to motorized travel, and would be less restrictive to the authorization of ROWs and surface disturbance in the area. Alternative A would be the least restrictive for oil and gas development and ROW authorizations, and may therefore result in the greatest potential for adverse impacts to the values of concern from surface disturbance due to these threats. A portion of the McCullough Peaks South Paleontological Area is included in the PETM ACEC under Alternative D; the *Paleocene-Eocene Thermal Maximum* section describes management of and impacts to this area.

4.7.1.30 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The McCullough Peaks South Paleontological area would be open to locatable mineral entry on 6,882 acres, open to mineral leasing (with primarily moderate constraints on 4,876 acres and major constraints on the remaining 2,105 acres), and primarily open to mineral materials disposal (6,567 acres). Mineral development is one of the threats to the paleontological and geological values of the area, and allowing this type of development with minimal restrictions would result in surface disturbance that would cause adverse impacts to the values of concern. Except for a small area of high-potential for sand and gravel, the low potential for bentonite and gypsum and very low development potential for oil and gas may minimize these adverse impacts.

The McCullough Peaks South Paleontological Area is primarily managed as open to ROW authorizations (5,709 acres), with the remainder managed as a ROW avoidance/mitigation area (1,250 acres). Allowing

ROW authorizations in the area would result in beneficial impacts to these authorizations. Managing this area as primarily open to ROW authorizations would result in adverse impacts to the values of concern by increasing the potential for surface disturbance and associated with ROW development.

Motorized vehicle use is limited to designated roads and trails in the area; thereby limiting access and use of certain roads in the area and limiting disturbance or degradation to the values of concern.

The McCullough Peaks South Paleontological Area is open to livestock grazing under Alternative A, which may result in adverse impacts to the paleontological values of concern in the area. However, impacts from concentrated livestock use, which can damage exposed paleontological resources, can be mitigated through proper livestock management that improves livestock distribution.

Applicable laws and regulations and the management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative A. These decisions include protective management, such as surveying and monitoring surface-disturbing activities for PFYC 5 and, on a case-by-case basis, PFYC 4 formations that would provide some protection to the paleontological values.

Alternative B

Management for the McCullough Peaks South Paleontological Area ACEC under Alternative B reduces adverse impacts from surface disturbance and development to the paleontological and geological values of concern in the area. Alternative B requires avoiding or prohibiting surface-disturbing activities in the McCullough Peaks South Paleontological Area ACEC, and prohibiting the use, occupation, construction, or maintenance of facilities that are inconsistent with the management direction and objectives for the area. Allowing minor surface-disturbing activities in the ACEC if they are preceded by a paleontological sensitivity survey and, if necessary, monitored during construction, would help to protect paleontological resources in the area. Restricting surface-disturbing activities may increase project costs and timeframes, but would continue to allow some activities while also protecting the integrity of fossil-bearing material in the area.

Withdrawing the McCullough Peaks South Paleontological Area ACEC from appropriation under the mining laws, managing the area as administratively unavailable to mineral leasing, and closing it to mineral materials disposal and geophysical exploration would result in greater adverse impacts to mineral development than Alternative A. Restricting mineral development would result in greater beneficial impacts to the paleontological and geologic values in the area than Alternative A. As described for Alternative A, the low potential for mineral resources in the area may minimize these impacts.

Alternative B is more restrictive than Alternative A regarding ROW management, motorized vehicle use, and livestock grazing; therefore, adverse impacts to these resource uses would be greater than under Alternative A. Alternative B manages the McCullough Peaks South Paleontological Area ACEC as a renewable energy and ROW avoidance/mitigation area, limits motorized vehicle use to designated roads and trails, and allows livestock grazing under existing regulations provided it does not disturb the natural, educational, and scientific research values of the ACEC. This management would reduce the potential for surface disturbance and would provide increased flexibility to further restrict activities (such as livestock grazing and resource-degrading travel routes) determined to be adverse to the values of concern. Conversely, any restrictions on grazing could reduce the currently available 722 AUMs in the ACEC and adversely affect livestock grazing. Requiring paleontological sensitivity surveys prior to approval of minor ROW authorizations may have long-term impacts by increasing processing times of authorizations and potentially requiring mitigation, relocation, or modification of facilities if paleontological resources are found.

Alternative B allows fossil collection, excavation, or removal in the McCullough Peaks South Paleontological Area ACEC only under a permit issued by the Wyoming BLM State Director and only by institutions and individuals engaged in BLM-approved research and museum or educational projects that provide for detailed recordation, reporting, care of specimens, and availability of specimens to other scientists and museums. Such requirements would, however, result in beneficial impacts by protecting the integrity of the resources and enabling the advancement of scientific knowledge in the area.

Alternative C

Alternative C does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

Management of and impacts associated with mineral development under Alternative C would be similar to those under Alternative A. The area is open to mineral leasing (with primarily moderate constraints on 4,405 acres, standard restrictions on 2,161 acres, and major constraints on the remainder), and open to mineral materials disposal on 6,772 acres.

ROW management in the McCullough Peaks South Paleontological Area under Alternative C is more restrictive than under Alternative A, but less than under Alternative B. The area is primarily an avoidance/mitigation area for ROW authorizations (3,776 acres) and open for ROW authorizations (3,218 acres) on the remainder. Management of ROWs under Alternative C would result in greater beneficial impacts to the values of concern in the ACEC than Alternative A, but less than Alternative B.

Management of and impacts associated with motorized vehicle use under Alternative C would be the same as under Alternative A.

Applicable laws and regulations and management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative C. This management would be less restrictive to surface disturbance than Alternative A, because it does not require on-the-ground surveys for PFYC 4 formations on a case-by-case basis.

Alternative D

Alternative D does not designate this area an ACEC. Part of the McCullough Peaks South Paleontological Area (4,958 acres) is within the proposed PETM ACEC. See the *Paleocene-Eocene Thermal Maximum* section for an analysis of the effects of management of this area.

Rainbow Canyon

Alternative B would designate the Rainbow Canyon area as an ACEC (1,443 acres); the other alternatives would not. The values of concern in the proposed Rainbow Canyon ACEC are paleontological resources in the form of dinosaurian and paleobotanical fossils, and weathered and eroded geologic and scenic features. Threats to this proposed ACEC include surface disturbance from mineral and ROW development.

4.7.1.31 Summary of Impacts by Alternative

Alternative B would be the most effective for protecting the paleontological and geologic values of concern in the Rainbow Canyon area. This alternative also would result in the greatest restrictions on mineral development, ROW authorizations, and other surface-disturbing activities; livestock grazing; and the excavation of paleontological resources. Alternatives A and C would allow mineral development and

would be less restrictive to the authorization of ROWs and surface disturbance in areas with paleontological resources than Alternative B. Alternative C would be the least restrictive for oil and gas development and ROW authorizations, and may therefore result in the greatest potential for adverse impacts to the values of concern from surface disturbance due to these threats. Alternative D manages mineral development similar to alternatives A and C and ROW authorizations similar to Alternative B.

4.7.1.32 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry, open to mineral leasing (with moderate constraints), and open to mineral materials disposal. Mineral development is one of the threats to the area and allowing this type of development, with minimal restrictions, would result in surface disturbance that would cause adverse impacts to the values of concern. The 1,238 acres of high-potential for bentonite would be the most likely location of minerals development, because the development potential for oil and gas is very low and the potential for gypsum and sand and gravel is low. The very low potential for most minerals may minimize the potential for adverse impacts to the values of concern.

The Rainbow Canyon area is primarily open to ROW authorizations (1,222 acres), with the remainder managed as an ROW avoidance/mitigation area (221 acres). Managing most of this area as open to ROW authorizations would result in adverse impacts to the values of concern by increasing the potential for surface disturbance and ROW development.

Motorized vehicle use is limited to designated roads and trails, which may result in fewer roads available to motorized travel in the area, compared to areas limited to existing roads and trails.

The Rainbow Canyon area is open to livestock grazing under Alternative A. Livestock trampling and wallowing in areas of concentrated livestock use can damage exposed paleontological resources. While, in most instances, concentrated livestock use would result in adverse impacts to paleontological values, proper management of livestock grazing can mitigate these impacts by improving livestock distribution.

Applicable laws and regulations and management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative A. These decisions include protective management, such as surveying and monitoring surface-disturbing activities for PFYC 5 and, on a case-by-case basis, PFYC 4 formations that may protect paleontological values of concern.

Alternative B

Management for the Rainbow Canyon ACEC under Alternative B reduces adverse impacts to the paleontological and geological values of concern from surface disturbance and development. Management under this alternative requires avoiding or prohibiting surface-disturbing activities in the Rainbow Canyon ACEC, and prohibiting the use, occupation, construction, or maintenance of facilities in the Rainbow Canyon ACEC that are inconsistent with the management direction and objectives for the area. Allowing minor surface-disturbing activities in the Rainbow Canyon ACEC if they are preceded by a paleontological sensitivity survey and, if necessary, monitored during construction, would help protect paleontological resources. Restricting surface-disturbing activities could increase project costs and timeframes, but would continue to allow some activities while also protecting the integrity of fossil-bearing material in the area.

Withdrawing the Rainbow Canyon ACEC from appropriation under the mining laws, managing the area as administratively unavailable to mineral leasing, and closing the area to mineral materials disposal and geophysical exploration would result in greater adverse impacts to mineral development than Alternative A. Restricting mineral development would result in greater beneficial impacts to the paleontological and geologic values in the area than Alternative A. As noted for Alternative A, impacts from the withdrawal would be greatest on the 1,238 acres of high-potential for gypsum; the low potential for other mineral resources in the area may minimize impacts from other types of mineral exploration and development.

Management under Alternative B is more restrictive than under Alternative A for ROWs and livestock grazing. Therefore, adverse impacts to these resource uses would be greater than under Alternative A. Alternative B manages the Rainbow Canyon ACEC as a renewable energy and ROW avoidance/mitigation area and allows livestock grazing under existing regulations, provided it does not disturb the natural, educational, and scientific research values of the Rainbow Canyon ACEC. This management would reduce the potential for surface disturbance and would provide increased flexibility to further restrict activities (such as livestock grazing) determined to be adverse to the values of concern. Any restrictions on grazing could reduce the currently available 23 AUMs in the area and adversely impact livestock grazing.

Management of and impacts associated with motorized vehicle use under Alternative B are the same as under Alternative A.

Alternative B allows fossil collection, excavation, or removal in the Rainbow Canyon ACEC only under a permit issued by the Wyoming BLM State Director and only by institutions and individuals engaged in BLM-approved research, museum, or educational projects that provide for detailed recordation, reporting, care of specimens, and availability of specimens to other scientists and museums. Such requirements would, however, result in beneficial impacts by protecting the integrity of the resources and enable the advancement of scientific knowledge.

Alternative C

Alternative C does not designate the area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

Management of and impacts associated with locatable and salable mineral development under Alternative C would be similar to those under Alternative A. However, the management of leasable minerals would be the least restrictive of any alternative because the area is managed as open to mineral leasing with primarily standard constraints (1,177 acres).

ROW management in the Rainbow Canyon area under Alternative C is less restrictive than alternatives A and B. The Rainbow Canyon area is managed as open to ROW authorizations (1,443 acres). Fewer restrictions on ROWs would result in more adverse impacts to the values of concern compared to the other alternatives.

Management of and impacts associated with motorized vehicle use under Alternative C would be the same as under Alternative A.

Applicable laws and regulations and management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative C. This management would be less restrictive to surface disturbance than under Alternative A, because it does not require on-the-ground surveys for PFYC 4 formations on a case-by-case basis.

Alternative D

Alternative D does not designate the area as an ACEC; the BLM would manage the area in accordance with multiple use principles consistent with other resource objectives.

Management of and impacts associated with mineral development under Alternative D would be the same as under Alternative A.

Under Alternative D, the Rainbow Canyon area is managed as an ROW avoidance/mitigation area and impacts would be the same as those under Alternative B.

Management of and impacts associated with motorized vehicle use under Alternative D would be the same as under Alternative A.

Applicable laws and regulations and management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative D. This management may be less restrictive of surface disturbance than under the other alternatives, because it does not require on-the-ground surveys for any PFYC class, although surveys and monitoring can be implemented on a case-by-case basis for PFYC 3-5 formations.

Paleocene-Eocene Thermal Maximum (PETM)

Alternative D would designate the PETM, in the Clarks Fork Basin/Polecat Bench, Foster Gulch, and McCullough Peaks South areas, as an ACEC (14,906 acres); alternatives A and C would not. Under Alternative B, the area of the PETM ACEC is entirely within the proposed Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs (58,189 acres total). The values of concern in the PETM ACEC are the same as those in the Clarks Fork Basin/Polecat Bench, Foster Gulch, and McCullough Peaks South ACECs (i.e., fossil resources and geochemical data from an ancient period of global warming). The PETM ACEC would manage a portion of the deposits of these resources protected under the Alternative B ACECs (referred to here as the greater-PETM area). Threats to the area of the PETM ACEC include surface disturbance from mineral (oil and gas, mineral materials, and possible locatable mineral mining), water withdrawals and irrigation outflow, timber extraction, recreational and OHV use, invasive and nonnative species infestations, and ROW development.

Management of and impacts from ACECs in the greater-PETM area under Alternative B, and management in this area without ACEC designations under alternatives A and C, are addressed in the *Clarks Fork Basin/Polecat Bench West Paleontological Area*, *Foster Gulch*, and *McCullough Peaks South* ACEC sections.

4.7.1.33 Summary of Impacts by Alternative

Only Alternative D designates the PETM ACEC. However, Alternative B manages ACECs that completely overlap this area, making it the most effective for protecting the paleontological and geological values of concern. In both the PETM ACEC area and the greater-PETM area covered by the Clarks Fork Basin/ Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs, Alternative B would be the most restrictive of oil and gas development, withdrawals, renewable energy development, ROW authorizations and other surface-disturbing activities, and motorized vehicle use. Under alternatives A and C, none of the area in the PETM ACEC or the greater-PETM area would be designated as an ACEC for the protection of paleontological values of concern. Management under these alternatives generally would be the least restrictive of mineral use and would provide the least protection from surface disturbance for the paleontological resources in the area. Alternative A would be the least restrictive of ROW and motorized vehicle use, followed by alternatives C and D.

4.7.1.34 Detailed Analysis of Alternatives

Alternatives A and C

Alternatives A and C do not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives. The proposed PETM ACEC is entirely within the Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs proposed under Alternative B. See the *Detailed Analysis of Alternatives* discussions for those ACECs for management of and impacts to this area under alternatives A and C.

Alternative B

Alternative B does not designate a PETM ACEC, but does manage a larger area as the Clarks Fork Basin/ Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs to protect the same values of concern. See the *Detailed Analysis of Alternatives* for the Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs for management of and impacts to this area under Alternative B.

Alternative D

Under Alternative D, the BLM designates a portion of the area managed as the Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs under Alternative B as the PETM ACEC to protect paleontological resources and geochemical data.

Allowing surface-disturbing activities and the use, occupation, construction, or maintenance of facilities that are consistent with the goals of the ACEC, would result in fewer adverse impacts, similar to those described for alternatives A and C in the Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs. In the greater-PETM area boundary proposed under Alternative B, impacts to paleontological resources would be the same as under alternatives A and C, because only standard restrictions on surface disturbance would apply. Alternative D restrictions throughout this area would be less effective for protecting paleontological resources than Alternative B, but also would cause fewer adverse impacts to project costs and timeframes associated with surface-disturbing activities, such as range improvements.

Under Alternative D, management of mineral development in the PETM ACEC and the greater-PETM area is less restrictive than under Alternative B and similar or slightly more restrictive than management under alternatives A and C. As with alternatives A and C, Alternative D manages most of the area as open for mineral leasing with moderate constraints; however, this alternative also applies a more restrictive NSO stipulation on the PETM ACEC itself and contains less area open with standard constraints on the greater-PETM area. Alternative D manages the PETM ACEC and the greater-PETM area as available for locatable mineral entry. However, unlike similar management under alternatives A and C, the area in the PETM ACEC would require a plan of operations for most locatable mineral exploration and development. The PETM ACEC is closed to mineral materials disposal, as is this area under Alternative B, and the greater-PETM area is managed as open to mineral materials disposal, similar to alternatives A and C. Although these restrictions would result in adverse impacts to mineral uses, these impacts may be minimized in the ACEC and the greater-PETM area because these areas consist of 29,736 acres of very low and 28,456 acres of low development potential for oil and gas, and low-potential for bentonite, gypsum, and sand and gravel across most of the area. Restricting mineral development would result in beneficial impacts to the values of concern for the ACEC by reducing the

potential for destruction or degradation of paleontological values and the other adverse impacts often associated with surface disturbance (e.g., the potential spread of invasive species).

Similar to Alternative C, under Alternative D approximately half of the PETM ACEC and the greater-PETM area are open to ROW authorizations and half is managed as ROW avoidance/mitigation areas. This management is more restrictive than Alternative A, but less restrictive than Alternative B. Alternative D would implement more restrictions on motorized travel within the PETM ACEC and the greater-PETM area than Alternative A, but fewer restrictions than alternatives B and C. Management of ROWs and motorized vehicle use under Alternative D would reduce the potential for impacts to these activities compared to Alternative B, but also would result in increased surface disturbance and other adverse impacts to the values of concern compared to that alternative. However, allowing ROW authorizations in the PETM only where consistent with the protection of paleontological resources would reduce these adverse impacts by allowing the further restriction of these activities where they would not be compatible with protecting the paleontological values of concern.

Management of and impacts from the collection, excavation, or removal of fossils in the PETM ACEC would be similar to in the Clarks Fork Basin/Polecat Bench West Paleontological Area, Foster Gulch, and McCullough Peaks South ACECs. In the greater-PETM area, the applicable laws, regulations, and management described in Section 4.5.2 *Paleontological Resources* control the collection of fossils under Alternative D. These decisions include protective management, such as surveying and monitoring surface-disturbing activities (on a case-by-case basis) and attaching standard Paleontological Resources Protection Stipulations for PFYC 3-5 formations, that would provide some protection to the paleontological values, but less than under Alternative B.

Rattlesnake Mountain

Alternative B would designate the Rattlesnake Mountain area as an ACEC (19,119 acres); the other alternatives would not. The values of concern to be managed for in the proposed Rattlesnake Mountain ACEC are special status species wildlife, varied vegetation communities and sensitive plants, and wildlife winter and transition habitat. Threats to this proposed ACEC include surface disturbance from mineral (including gravel pits) and ROW development, renewable energy developments (wind energy), timber extraction, heavy recreational and OHV use, and invasive, nonnative species infestations. These activities threaten rare plants and habitat for special status species, and have the potential to create disturbances for wintering wildlife.

4.7.1.35 Summary of Impacts by Alternative

Alternative B would be the most effective for protecting the special status species, vegetation, and wildlife winter and transition habitat values of concern in the Rattlesnake Mountain area. This alternative would result in the least habitat fragmentation due to surface disturbance and the smallest potential for invasive species infestation. Alternative B also would result in the greatest restrictions on mineral development, ROW authorizations, renewable energy development, and surface-disturbing activities. Alternatives A, C, and D would allow mineral development and would be less restrictive to travel and surface disturbance. Alternative D would be more restrictive of ROWs than alternatives A and C. Alternative C would be the least restrictive for oil and gas development and ROW authorizations (including renewable energy development), and may therefore result in the greatest potential for adverse impacts to the values of concern. Alternatives A and D would result in the greatest potential for adverse impacts to wildlife due to travel-related disturbance during sensitive times of the year.

4.7.1.36 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry, open to mineral leasing (with primarily major constraints on 13,791 acres and moderate constraints on 4,528 acres), and open to mineral materials disposal. Mineral development would be most likely on the small areas with high-potential for gypsum (291 acres) and sand and gravel (928 acres); the potential for bentonite is low and the development potential for oil and gas is very low. Surface disturbance from mineral development is one of the threats and allowing this type of development, with minimal restrictions, would result in surface disturbance and increased potential for invasive species infestations. This type of development also would result in adverse impacts to special status species and wildlife winter and transition habitat due to increased fragmentation and increased potential for disturbance of wildlife during sensitive times of the year when these habitats are in use.

The Rattlesnake Mountain area is managed as open to ROW authorizations (9,179 acres) and as an ROW avoidance/mitigation area (9,940 acres). Areas open to ROW authorizations would be more likely to experience surface disturbance, an identified threat to the values of concern, and adverse impacts similar to those from mineral development. Areas with fewer restrictions would benefit ROW authorizations by increasing the potential for development in these areas. Interest in ROW authorizations in the form of wind-energy development are of concern in this area. Development of wind energy would result in adverse impacts to the values of concern due to large wind turbines, construction activities, and required infrastructure (e.g., roads, transmission lines, facilities).

Alternative A limits motorized vehicle use primarily to designated roads and trails (18,662 acres), with a much smaller area limited to existing roads and trails (457 acres). Managing the area as primarily limited to designated roads and trails would reduce fragmentation of habitat and reduce stress on wildlife during sensitive times of the year.

Standard guidelines related to surface disturbance would apply in the area. Although these standard guidelines may reduce the severity of impacts to the values of concern from surface disturbance, adverse impacts still would be likely if surface-disturbing activities are authorized.

Alternative B

Management for the Rattlesnake Mountain ACEC under Alternative B reduces adverse impacts to the values of concern in the area by prohibiting surface-disturbing activities. Surface disturbance prohibitions would result in beneficial impacts to special status species and wildlife winter and transition habitat because it would reduce fragmentation, the potential for invasive species infestation, and the disturbance of wildlife during sensitive times of the year when these habitats are in use. This management is more restrictive to surface-disturbing activities in the Rattlesnake Mountain area compared to the other alternatives.

Withdrawing the Rattlesnake Mountain ACEC from appropriation under the mining laws, managing the area as administratively unavailable to mineral leasing, and closing the area to mineral materials disposal and geophysical exploration would result in more adverse impacts to mineral development than Alternative A. Conversely, restricting mineral development would result in greater beneficial impacts to the values of concern than Alternative A. However, the low potential for most mineral resources in the area may minimize these impacts.

Alternative B is more restrictive than Alternative A regarding ROWs and motorized vehicle use. The Rattlesnake Mountain ACEC is an ROW exclusion area, a renewable energy exclusion area, and seasonally closed to motorized and mechanized vehicle use on part and limited to designated roads and trails on the remainder. Under Alternative B, more restrictive ROW and travel management would result in greater adverse impacts to ROW and wind-energy development in this area, and would adversely affect the ability of the public to access the area compared to Alternative A by limiting the times of year and routes available for travel. Conversely, limiting travel seasonally would allow additional protection for wildlife during sensitive times of the year, and beneficial impacts to these values of concern would be greater under Alternative B than Alternative A.

Allowing and seasonally stipulating vegetative/silviculture treatments, invasive/nonnative pest species control, fuels management, and maintenance of existing facilities in the Rattlesnake Mountain ACEC would protect wildlife and special status species during sensitive times of the year, while still allowing maintenance and treatments to occur.

Alternative C

Alternative C does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives. Standard guidelines related to surface disturbance would apply, with impacts similar to those under Alternative A.

Management of and impacts associated with mineral development under Alternative C would be similar to Alternative A. The area is open to mineral leasing (with primarily moderate constraints on 18,439 acres).

The Rattlesnake Mountain area is managed as open to ROW authorizations (18,824 acres), with a smaller portion managed as an ROW avoidance/mitigation area (294 acres). The area open to ROW authorizations would greater than under Alternative A, and the extent of adverse impacts to the values of concern described under Alternative A would be greater than under Alternative C. This alternative would be the most beneficial to ROW and wind developments of any alternative by managing the area with the least restrictions on ROW and renewable energy development.

Motorized vehicle use is managed primarily as limited with seasonal stipulations (13,709 acres), with a smaller area limited to designated roads and trails (5,409 acres). Impacts to and from travel would be similar to those described under Alternative B.

Alternative D

Alternative D does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives. Standard guidelines related to surface disturbance would still apply, with similar impacts as Alternative A.

Management of and impacts associated with mineral development under Alternative D would be similar to Alternative C. The area is available for locatable mineral entry, open to mineral leasing (with moderate constraints), and open to mineral materials disposal.

The Rattlesnake Mountain area is managed as an ROW avoidance/mitigation area. Management of ROW authorizations would be less restrictive (and more beneficial to the values of concern) than under Alternative B, and more restrictive (and less beneficial to the values of concern) than under alternatives A and C.

Alternative D limits motorized vehicle use to designated roads and trails, and impacts would be the same as under Alterative A.

Sheep Mountain

Alternatives B (25,153 acres) and D (14,201 acres) would designate the Sheep Mountain area as an ACEC; alternatives A and C would not. The values of concern in the proposed Sheep Mountain ACEC are varied vegetation communities, sensitive plants, and big game wildlife habitat.

4.7.1.37 Summary of Impacts by Alternative

Alternatives B and D are the only alternatives that designate the Sheep Mountain area as an ACEC. Due to the larger size and more restrictive management, Alternative B would be the most effective for protecting the vegetation communities, sensitive plants, and big game wildlife habitat in the Sheep Mountain area due to resource use restrictions and travel designations. Management under Alternative B includes the greatest restrictions on ROWs, minerals development, and other surface-disturbing activities in the area, resulting in the greatest adverse impacts to these resource uses compared to the other alternatives. Alternative B would be the most restrictive of travel in the area, and would therefore provide the greatest protection of the values of concern from fragmentation and disruption related to motorized vehicle use.

4.7.1.38 Detailed Analysis of Alternatives

Alternative A

Alternative A does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry except on 560 acres, open to mineral leasing (with primarily major constraints on 18,943 acres and moderate constraints on the remaining 6,210 acres), and open to mineral materials disposal on 24,574 acres and closed on 579 acres. Allowing mineral development in areas open to minerals would result in beneficial impacts to these resource uses. Mineral development would result in surface disturbance and habitat fragmentation that would result in adverse impacts to vegetation and big game wildlife habitat values in the area.

The Sheep Mountain area is managed as open to ROW authorizations (19,475 acres) or as an ROW avoidance/mitigation area (5,607 acres). Standard guidelines related to surface disturbance would apply. Alternative A limits motorized vehicle use primarily to designated roads and trails (22,926 acres), and limits motorized vehicle use in a smaller area to existing roads and trails (2,227 acres).

Standard guidelines related to surface disturbance would apply and may reduce the severity of impacts to the values of concern from surface disturbance. There would still be adverse impacts if surface-disturbing activities are authorized.

Alternative B

Under Alternative B, prohibiting surface-disturbing activities in the Sheep Mountain ACEC would restrict such activities as geophysical exploration and road construction, but would benefit vegetation communities, sensitive plants, and big game habitat by limiting the potential for fragmentation or invasive species infestations that would degrade vegetation and habitat.

Under Alternative B, restrictions on mineral development would result in adverse impacts to the use of these resources or beneficial impacts to the values of concern by reducing surface-disturbing activities and disruptions. The ACEC is withdrawn from appropriation under the mining laws and closed to mineral materials disposal. Adverse impacts to mineral resources would be greatest in areas of high-

potential for gypsum and bentonite (2,809 acres and 1,953 acres, respectively) or sand and gravel (13,648 acres). The ACEC is administratively unavailable for mineral leasing, but the development potential for oil and gas is very low to low and adverse impacts would be minimal.

Under Alternative B, the Sheep Mountain ACEC is an ROW and renewable energy avoidance/mitigation area. Of all the alternatives, this management is the most restrictive to future ROW authorizations and the most restrictive to ROW-related surface disturbance and disruption that would adversely affect the wildlife and vegetation values of concern. Therefore, management of ROWs and renewable energy would result in the greatest beneficial impacts to the values of concern in the ACEC compared to the other alternatives.

A portion (13,023 acres) of the Sheep Mountain ACEC is seasonally restricted and the remainder (11,905 acres) is limited to designated roads and trails for motorized and mechanized vehicle use. Limiting or closing the ACEC to motorized vehicle use would result in adverse impacts to travel and access and beneficial impacts on the values of concern. Closing this area would eliminate disruption from motorized vehicles to wildlife and may reduce disturbance of vegetation and sensitive plants. Management under this alternative would be the most restrictive to motorized vehicle travel, but would result in the greatest beneficial impacts to the values of concern in the area compared to the other alternatives.

Seasonally stipulating, where feasible, vegetative/silviculture treatments, invasive/nonnative pest species control, fuels management, and maintenance of existing facilities in the Sheep Mountain ACEC would protect wildlife during sensitive times of the year, while still allowing maintenance and treatments to occur.

Alternative C

Alternative C does not designate the area as an ACEC; the BLM manages the area in accordance with multiple use principles consistent with other resource objectives.

The area would be open to locatable mineral entry except on 560 acres, open to mineral leasing (with primarily moderate constraints on 24,011 acres, major constraints on 976 acres, and standard stipulations on 166 acres), and entirely open to mineral materials disposal. Management of minerals would allow for the greatest level of mineral development in the area and would result in the greatest adverse impacts to the values of concern compared to the other alternatives.

ROW management in the Sheep Mountain area is open to ROW authorizations (19,865 acres), with a smaller portion managed as avoidance/mitigation for ROW (5,288 acres). Standard guidelines related to surface disturbance would apply; however, the additional restrictions under Alternative B would not. Alternative C is less restrictive to ROW authorizations than Alternative A. Management of ROWs under Alternative C would result in the greatest adverse impacts to the values of concern in the area compared to the other alternatives.

Alternative C limits motorized vehicle use primarily to designated roads and trails (11,630 acres) or imposes seasonal restrictions (13,248 acres), and limits a smaller area to existing roads and trails (275 acres). Impacts to motorized travel are generally expected to be similar to Alternative A.

Standard guidelines related to surface disturbance would apply and could result in additional surface disturbance in the area compared to alternatives A and B, leading to potential increased degradation of the values of concern in the area.

Alternative D

Surface-disturbing activities are allowed in the Sheep Mountain ACEC and the larger area managed as an ACEC under Alternative B, reducing the potential for adverse impacts to activities such as ROWs and range improvement projects compared to Alternative B. Allowing these activities would result in adverse impacts to the values of concern similar to Alternative A, although these impacts would be reduced in the ACEC under Alternative D. Surface-disturbing activities in the ACEC are limited to slopes of 15 percent or less, except where needed to improve watershed function, wildlife habitat, or land health.

Alternative D does not pursue a withdrawal for the Sheep Mountain ACEC, and only a small portion of the larger area proposed under Alternative B (54 acres) is withdrawn to meet other resource objectives. Management of and impacts from locatable mineral entry under this alternative would be similar to Alternative A, and the adverse impacts to mineral uses and beneficial impacts to habitat identified under Alternative B would not occur.

As under Alternative B, the Sheep Mountain ACEC is closed to mineral materials disposal and administratively unavailable for mineral leasing; however, the larger area designated as an ACEC under Alternative B is available for locatable mineral entry, open to mineral materials disposal, and only managed as administratively unavailable to oil and gas leasing on a portion (6,085 acres) under this alternative. Impacts in the Alternative D ACEC would be the same as under Alternative B; impacts in the larger area managed as an ACEC under Alternative B would be less adverse to the use of mineral resources. The less restrictive management of mineral uses under this alternative would reduce the beneficial impacts to the values of concern compared to Alternative B. As noted for Alternative B, the very low to low development potential for oil and gas would minimize both adverse impacts to leasing and the benefit of leasing restrictions on the values of concern under Alternative D. However, adverse impacts to mineral materials disposal would still exist in areas of high-potential for sand and gravel. Under Alternative D, management of and impacts from ROWs and renewable energy in the Sheep Mountain ACEC and the larger area designated as an ACEC under Alternative B would be the same as under Alternative B.

Under Alternative D, motorized vehicle use in the Sheep Mountain ACEC and most of the larger area managed under Alternative B is limited to designated roads and trails (24,945 acres). Impacts to motorized travel would be similar to Alternative A.

Similar to Alternative B, under Alternative D, the BLM can stipulate, where feasible, treatment and maintenance activities in the Sheep Mountain ACEC to protect wildlife, while still allowing maintenance and treatments to occur. In the larger area proposed as an ACEC under Alternative B, the standard guidelines related to surface disturbance and the management of other resource objectives would manage these activities; therefore, under Alternative D, impacts in this area would be similar to Alternative A.

4.7.2 National Back Country Byways

This section describes the impacts of each alternative to National Back Country Byways, which are an important recreational resource on BLM-administered lands. These travel routes are frequently used and are susceptible to impacts over the long term. Adverse impacts to National Back Country Byways result from management actions that substantially limit or prevent public use. Beneficial impacts result from actions that enhance the use of Back Country Byways. Direct impacts include any action that substantially alters the use of the byways. Indirect impacts include actions that alter the setting of the byways and influence user experiences.

The Red Gulch/Alkali Road National Back Country Byway is the only currently designated back country byway in the Planning Area. Under Alternative B, two additional back country byways, the Hyattville Logging Road and the Hazelton (33-Mile) Road, are proposed for designation.

4.7.2.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Under Alternative B, no additional land use constraints are associated with designation of the Hyattville Logging Road and the Hazelton (33-Mile) Road Back Country Byways.
- Impacts to other resources from management of the cultural values along the proposed and existing back country byways are discussed in Section 4.5.1 *Cultural Resources*.
- Establishment of the Hyattville Logging Road and the Hazelton (33-Mile) Road Back Country Byways will increase use of the roads and increase human presence in these areas.

4.7.2.2 Summary of Impacts by Alternative

National Back Country Byways are designated to protect important recreational travel routes; the primary impacts to these routes include management that limits or prevents public use. Designation of the Red Gulch/Alkali Road National Back Country Byway would continue under all alternatives. Alternative B designates two additional back country byways, Hyattville Logging Road and the Hazelton (33-Mile) Road; Alternative D designates the Hyattville Logging Road and considers additional designations on a case-by-case basis. Alternatives A and C do not designate additional byways. Designation of additional back country byways would provide beneficial impacts by increasing opportunities for interpretation and education. Management for the development of interpretive facilities and educational materials under Alternative B is more extensive than under alternatives A, C, and D and may result in beneficial impacts to user experiences and increases in appropriate use that does not degrade the byways. Regardless of whether they are designated, adverse and beneficial impacts from the Red Gulch/Alkali Road National Back Country Byway, Hyattville Logging Road, and the Hazelton (33-Mile) Road on other resource values would be negligible under all alternatives.

4.7.2.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Management of the Red Gulch/Alkali Road National Back Country Byway does not change substantially across alternatives; therefore, all impacts are common to all alternatives.

Under all alternatives, the Red Gulch/Alkali Road National Back Country Byway continues its existing designation. Management of cultural and environmental interpretation and education along the byway would continue according to the Red Gulch/Alkali National Back Country Byway Interpretive Master Plan (BLM 1994a). Existing adverse and beneficial impacts from the Red Gulch/Alkali Road National Back Country Byway, Hyattville Logging Road, and the Hazelton (33-Mile) Road will continue under all alternatives regardless of designation and are considered negligible. Long-term adverse impacts from the current Type III and IV character of the roads (see *Glossary*) are the same as impacts from similar primitive roads in the Planning Area and include habitat fragmentation, fugitive dust, increased erosion, and potential spread of invasive, nonnative plant seeds and/or parts.

Alternative A

Developing educational materials for the Red Gulch/Alkali Road National Back Country Byway may result in beneficial impacts by increasing knowledge and appropriate use of the area. Beneficial impacts from the Red Gulch/Alkali Road Back Country Byway include maintaining a viable transportation route, back country access, and recreation, wildlife, and scenic viewing opportunities. These benefits allow a positive change for residents and visitors, providing the opportunity to experience aesthetic appreciation, identify with a special place, improve perception of the quality of life, and improve the image of the area and its recreational opportunities. Environmental benefits include creating a sense of "ownership" and stewardship of the area, while protecting natural habitats and open space by reducing the temptation for recreationists to travel off-road. Economic benefits include retaining recreational spending in local areas, increased contributions to local economies, and increased attractiveness of the area.

Potential adverse impacts from maintaining the back country byway include increased use of Red Gulch/Alkali Road and potential increases in soil erosion, road maintenance, and fugitive dust from traffic. In addition, increased human presence and activity in the area may adversely affect biological and cultural resources due to litter, unauthorized plant collection, the spread of invasive species, vandalism, and wildlife disturbance.

Alternative A does not designate other back country byways.

Alternative B

Alternative B would designate two additional back country byways, the Hyattville Logging Road and the Hazelton (33-Mile) Road.

Developing interpretive facilities (including interpretive pull-outs, parking areas, trailheads, etc.) on all back country byways (including the Red/Gulch Alkali Back Country Byway), and publishing educational brochures displaying the multiple uses, resource values, and unique character of each byway would result in beneficial impacts by enhancing users' experiences and encouraging appropriate use that does not degrade the byways. Beneficial and adverse impacts from designating the additional two back country byways would be similar to those under Alternative A. However, the extent of impacts under Alternative B would be greater as the designations affect more areas, possibly including areas outside the Planning Area's jurisdiction, such as the Casper and Buffalo Field Offices, due to the influence and connectivity of the Hazelton (33-Mile) Road.

Alternative C

Developing educational materials for the Red Gulch/Alkali Road National Back Country Byway would result in the same beneficial impacts as Alternative A.

Alternative C does not designate other back country byways.

Alternative D

Alternative D would designate the Hyattville Logging Road Back County Byway in addition to retaining the Red Gulch/Alkali Road National Back Country Byway. Beneficial and adverse impacts from designating the Hyattville Logging Road Back Country Byway would be similar to, but greater than, those described under Alternative A and less than those under Alternative B. Alternative D also considers the designation of new back country byways on a case-by-case basis, which may expand the extent of impacts described under Alternative A if more byways are designated.

Similar to alternatives A and C, this alternative does not require the BLM to develop interpretive facilities. However, Alternative D does allow the BLM to consider developing such facilities (including interpretive pull-outs, parking areas, trailheads, etc.) on the Hyattville Logging Road Back Country Byway and the Red/Gulch Alkali National Back Country Byway and publishing educational brochures displaying the multiple uses, resource values, and unique character of each byway, which may result in impacts similar to those under Alternative B, but to a lesser extent.

4.7.3 National Historic Landmarks

The Heart Mountain Relocation Center National Historic Landmark is on BLM-administered mineral estate with BLM-administered surface in view of the site. National Historic Landmarks are very high profile by definition, so adverse impacts to these areas are more controversial than impacts to NRHP sites. Adverse impacts to the Heart Mountain Relocation Center National Historic Landmark would be similar to those described in Section 4.5.1 *Cultural Resources*, with a greater emphasis on impacts to the viewshed of the National Historic Landmark. BLM actions that alter the scenic characteristics of the landscape around the Heart Mountain Relocation Center National Historic Landmark or adversely affect the viewshed would adversely impact the integrity of the National Historic Landmark and, therefore, could affect the historical significance of this resource. Beneficial impacts are those that preserve the setting around the National Historic Landmark to maintain its historical character and significance.

4.7.3.1 Methods and Assumptions

Certain projects, due to size or topography, may require consideration of visual intrusions into the setting beyond the foreground or middle-ground zones to comply with NHPA Section 106.

See Section 4.5.1 *Cultural Resources* for assumptions applicable to the impacts analysis for National Historic Landmarks.

4.7.3.2 Summary of Impacts by Alternative

The Heart Mountain Relocation Center National Historic Landmark is on BLM-administered mineral estate with BLM-administered surface in view of the site. Impacts to the National Historic Landmark principally result from activities that affect the site's historical setting (i.e., viewshed). Under all the alternatives, the 72-acre National Historic Landmark would be withdrawn from appropriations under the mining laws and protected from direct impacts from surface-disturbing activity associated with mineral development. The greatest adverse impacts to the National Historic Landmark would occur under Alternative A, which applies the fewest restrictions on mineral development within the viewshed of the National Historic Landmark. Alternative B restricts surface-disturbing mineral development in the viewshed of the National Historic Landmark to the greatest degree, resulting in the greatest beneficial impacts under this alternative, followed by alternatives D, C, and A respectively.

4.7.3.3 Detailed Analysis of Alternatives

Impacts from surface-disturbing activities, resource uses, and proactive management actions may result in adverse and beneficial impacts to the Heart Mountain Relocation Center National Historic Landmark.

Impacts Common to All Alternatives

The BLM complies with NHPA Section 106 for all actions with the potential to adversely impact historic properties (i.e., cultural resources eligible for, or listed on, the NRHP, including those designated as National Historic Landmarks). If historic properties are present, the BLM consults with the SHPO and

other interested parties in developing mitigation measures for adversely affected properties. These measures would minimize adverse impacts to the Heart Mountain Relocation Center National Historic Landmark under all of the alternatives.

Under all of the alternatives, the BLM pursues a withdrawal from appropriation under the mining laws for the 72 acres of BLM-administered mineral estate underlying private and other federal agency-administered surface lands in the Heart Mountain Relocation Center National Historic Landmark. Preventing mining activities on areas in the National Historic Landmark would result in beneficial impacts by maintaining the historic setting of the area to its historical significance.

Surface-disturbing activities and ROW development would have similar impacts on the Heart Mountain Relocation Center National Historic Landmark under all alternatives, but their intensity is likely to vary. Therefore, these impacts are analyzed under each alternative. Proactive management would result in varying beneficial impacts to the National Historic Landmark under each alternative.

Alternative A

Surface Disturbance

Oil and gas development, mining, and other surface-disturbing activities would threaten the historical landscape and viewshed around the Heart Mountain Relocation Center National Historic Landmark. Projected surface disturbance under Alternative A (Table 4-1) would result in the potential for alterations of the scenic characteristics in the surrounding landscape that may adversely affect the historical significance of the National Historic Landmark.

Resource Uses

ROW authorizations, especially for wind-energy development, also may cause visual impacts that may affect the setting and viewshed of the National Historic Landmark. Under Alternative A, the BLM considers renewable energy development on a case-by-case basis throughout the Planning Area and manages 941,778 acres as ROW avoidance/mitigation areas and 61,416 acres as ROW exclusion areas. Less restrictive ROW management actions would allow for dispersed ROW development and the potential for visual impacts. Therefore, Alternative A would result in potential adverse impacts to the National Historic Landmark from ROW development.

Proactive Management

Other than the withdrawal specified under Impacts Common to All Alternatives, no alternative-specific proactive management actions are prescribed for the Heart Mountain Relocation Center National Historic Landmark under Alternative A.

Alternative B

Surface Disturbance

Impacts to the National Historic Landmark from surface disturbance would be similar to, but less than, under Alternative A. Projected surface disturbance under Alternative B (Table 4-1) would result in the smallest potential for alterations of the scenic characteristics in the surrounding landscape that may result in adverse impacts to the setting and viewshed of the National Historic Landmark.

Resource Uses

Impacts to the National Historic Landmark from ROW development under Alternative B are similar to, but less than, under Alternative A. Under Alternative B, the Planning Area is open to renewable energy

development unless managed as a renewable energy or ROW exclusion or avoidance/mitigation area. The BLM manages 2,717,617 acres as ROW avoidance/mitigation areas and 225,750 acres as ROW exclusion areas, with 246,448 acres open to renewable energy. This alternative consolidates new ROW development more than the other alternatives, which may reduce the potential for impacts to the setting and viewshed of the Heart Mountain Relocation Center National Historic Landmark compared to the other alternatives.

Proactive Management

Under Alternative B, the BLM avoids surface-disturbing activities in view within 5 miles (2,736 acres) of the Heart Mountain Relocation Center National Historic Landmark, except within existing utility corridors; manages areas within 3 miles as administratively unavailable for mineral leasing and applies a CSU stipulation in view within 5 miles or the visual horizon; and closes the area within 3 miles and in view within 5 miles to mineral materials disposal. These proactive management actions would provide the greatest benefit to the National Historic Landmark, compared to the other alternatives, by protecting the setting around the National Historic Landmark and contributing to the preservation of its historical integrity.

Alternative C

Surface Disturbance

Impacts to the Heart Mountain Relocation Center National Historic Landmark from surface disturbance would be similar to, but greater than, those under Alternative A. Projected surface disturbance under Alternative C (Table 4-1) would result in the greatest potential for alterations to the viewshed, resulting in adverse impacts to the setting of the National Historic Landmark.

Resource Uses

Impacts from ROW development near Heart Mountain Relocation Center National Historic Landmark under Alternative C would be similar to those described for Alternative A, but less than under Alternative A and more than under alternatives B and D. Under Alternative C, the Planning Area is open to renewable energy development unless managed as a ROW exclusion or avoidance/mitigation area. The BLM manages 1,174,335 acres as ROW avoidance/mitigation areas and 7,762 acres as ROW exclusion areas, with 1,425,762 acres open to renewable energy. ROW consolidation under Alternative C would result in fewer adverse impacts than Alternative A, but more than alternatives B and D.

Proactive Management

Proactive management under Alternative C would result in fewer beneficial impacts to the Heart Mountain Relocation Center National Historic Landmark than under Alternative B. The BLM does not apply a buffer to prohibit surface-disturbing activities around the National Historic Landmark, but does manage areas within the footprint of the original Heart Mountain Urban Area (912 acres) as administratively unavailable for mineral leasing and closes areas within ¼ mile (255 acres) and in view within 1 mile to mineral materials disposal.

Alternative D

Surface Disturbance

Impacts to the Heart Mountain Relocation Center National Historic Landmark from surface disturbance under Alternative D would be similar to those under Alternative A. Alternative D results in 3 percent more short-term and 17 percent more long-term surface disturbance than Alternative A, with a

proportional degree of potential adverse impacts to the National Historic Landmark. Overall, surface disturbance under Alternative D would result in the second highest potential for adverse impacts to the National Historic Landmark.

Resource Uses

Impacts to the Heart Mountain Relocation Center National Historic Landmark from ROW development near the National Historic Landmark under Alternative D would be similar to, but less than those under Alternative A, less than under Alternative C, and more than under Alternative B. Under Alternative D, the Planning Area is open to renewable energy development unless managed as a ROW exclusion or avoidance/mitigation area. The BLM manages 2,512,202 acres as ROW avoidance/mitigation areas and 39,003 acres as ROW exclusion areas, with 393,593 acres open to renewable energy. ROW consolidation under Alternative D would be similar to Alternative C, and would result in greater adverse impacts than under Alternative B, but less than under Alternative A.

Proactive Management

Proactive management under Alternative D would result in fewer beneficial impacts than under Alternative B, but more than under alternatives A and C. Measures to preserve the viewshed around the Heart Mountain Relocation Center National historic Landmark under Alternative D, including not authorizing undertakings of moderate or strong contrast, except ROWs within the utility corridors (Map 54); requiring all undertakings in the viewshed to have a visual contrast rating and visual simulation, as appropriate; and avoiding or mitigating adverse impacts from all undertakings within the viewshed would protect the National Historic Landmark's historical setting and contribute to the preservation of its historical integrity. Alternative D also restricts mineral leasing in the vicinity of the National Historic Landmark similarly to, but more than Alternative C, and prohibits mineral materials disposal within the 72 acres of the National Historic Landmark Urban Center. Overall, proactive management actions under Alternative D would protect the historical setting of the National Historic Landmark more than alternatives A and C, but less than Alternative B.

4.7.4 National Historic Trails and Other Historic Trails

The Nez Perce (Neeme-poo or Nimi'ipuu) NHT is the only NHT in the Planning Area. A number of Other Historic Trails also pass through the Planning Area, including trails of importance to Native Americans, routes from the early historic period, such as the Bridger Trail, and roads and highways from the late 19th and early 20th centuries. Map 73 illustrates the Nez Perce NHT and Other Historic Trails.

NHTs and Other Historic Trails are fragile, nonrenewable resources that provide a direct and tangible link to human history in the Planning Area. As resources on public land under the jurisdiction of a federal agency, the BLM is responsible for their protection and interpretation, and must consider their value when making land use decisions.

Adverse impacts to trail resources are primarily the result of direct impacts from actions that disturb the soil or alter characteristics of the surrounding environment that contribute to the trail's significance. This includes the introduction of visual elements out of character with the existing scenery, or other actions that alter the setting or result in neglect of the resource to the extent that it deteriorates or is destroyed. For example, surface-disturbing activities that impact trail ruts are considered adverse impacts because the trail segments are nonrenewable. In contrast, actions that result in data collection and preservation of NHTs and Other Historic Trails can be considered beneficial impacts. Beneficial impacts also include proactive trail management, such as the preservation of buffer zones.

Indirect impacts to NHTs and Other Historic Trails primarily result from project-related increases or decreases in activity in the Planning Area. For example, the construction of a recreational facility may increase visitor use, which would result in an indirect impact to previously undisturbed trail segments. Recreation in particular is a complex issue, because actions taken to preserve historic values can result in both beneficial and adverse impacts for the resource, and for heritage tourism and trail enthusiasts. Construction in an area some distance from a trail also can result in erosion or deposition at a trail location.

Because of the nonrenewable nature of NHTs, there is little distinction between short-term and long-term impacts. An exception to this would be visual impacts related to temporary construction or fire-related impacts. For example, a change in vegetation resulting from fire or clearing would be a temporary impact, as long as it did not lead to erosion of the trail. Similarly, if construction activity temporarily intruded into the trail's viewshed, this would be a temporary impact, as long as the construction itself did not directly affect the trail or result in a condition that may lead to indirect impacts.

For all federal undertakings that may impact NHTs and Other Historic Trails, the BLM complies with NHPA Section 106 before implementing the undertaking. Section 106 compliance typically includes inventory, evaluation, and consultation with the SHPO. The existing plans considered the maintenance of a ¼-mile buffer zone adequate protection in most trail situations, with the occasional application of a 5-mile buffer zone a generous allowance that would provide protection to the viewshed of the Nez Perce NHT. However, with the introduction of new technology, particularly wind turbines that are often grouped into wind farms, this distance does not protect the Nez Perce NHT's resource values. As setting has gained importance in determining the NRHP eligibility of significant trails, trail management must approach the application of viewshed criteria with flexibility, considering the distance from the resource and the type of intrusion when determining the impact. On a case-by-case basis, and as appropriate for some projects, project decisions will consider the importance of viewshed in a resource's eligibility, and the distance necessary to protect its NRHP significance.

Application of the standards specified in BLM trail management guidance, and in the 1986 historic trails plan (BLM 1986b), also will limit adverse impacts to trail resources. These standards include:

- Avoid impacts to all physical remains with good integrity.
- Avoid impacts to locales with good environmental integrity.
- Cross the setting where the integrity of setting has already been compromised.
- Avoid running a linear project parallel to a trail.
- Cross at 90 degrees using a dog-leg or S-curve.
- Relocate the proposed disturbance where it will be less visible from the trail (i.e., behind a rise).
- Restrict the width of a working ROW within a visual buffer on either side of a trail.
- Avoid any blading on a ROW within the buffer zone if a track can do the job.
- Consider special rehabilitation measures (such as revegetation) which will help reestablish the integrity of the trail.
- Consider special interpretive measures (such as signing) which will help mitigate the impact of the project.

4.7.4.1 Methods and Assumptions

This impact analysis employs BLM trail management guidelines (BLM 1986b) to determine the impacts to NHTs and Other Historic Trails from the management of other resources, as described in this RMP. Other Historic Trails are trails eligible for listing on the NRHP, whether or not they have been listed. Completion of the evaluation step of Section 106 compliance may be necessary before moving forward with an undertaking that impacts a trail. Trails will be evaluated for eligibility based on the guidelines provided in the 1986 trails management guide, as interpreted in light of contemporary understanding of eligibility criteria.

Methods and assumptions used in this impact analysis include the following:

- Protection of NHTs and Other Historic Trails and related sites occurs in accordance with federal laws and BLM regulations and agreements, including the BLM National Programmatic Agreement (BLM, ACHP, and National Conference of State Historic Preservation Officers 1997) and the Wyoming State Protocol (BLM and Wyoming SHPO 2006), regardless of whether the trails are specifically identified in the RMP.
- Direct and indirect impacts can result from a variety of natural and human-caused events, such as those that physically alter, damage, or destroy all or part of the trail; improve access, bringing increased use to an area, altering characteristics of the surrounding environment that contribute to the trail's importance; the introduction of visual or audible elements out of character with the trail or that alter its setting; and neglect of the trail to the extent that it deteriorates or is destroyed.
- The intensity of surface disturbance by alternative as identified in Appendix T equates to levels of development and, in turn, increased access to public lands.
- The BLM looks favorably at opportunities to cooperate with private landowners to minimize or eliminate disturbance to NHTs and Other Historic Trails.
- Recognizing that historic trails often comprise numerous routes rather than a single trace, all protective zones begin at the outer edges of trails rather than at a centerline, which is difficult to define.
- Certain projects, due to size or topography, may require consideration of visual intrusions into the setting beyond the foreground or middle-ground zones to become consistent with the modern understanding of impacts, and to comply with Section 106 of the NHPA.

4.7.4.2 Summary of Impacts by Alternative

Principle impacts to the Nez Perce (Neeme-poo or Nimi'ipuu) NHT, the only NHT in the Planning Area, and Other Historic Trails arise directly from development activities and intrusions into the viewshed that alter the environment that contributes to the trail's significance. Alternative B provides the greatest protection for these trails through the application of larger buffer zones for surface-disturbing activity (both NSO and CSU) and restrictions on motorized vehicle use. The larger acreage of special designations and limited resource use under Alternative B reduce the potential for direct and indirect adverse impacts. Alternative C allows the greatest resource use, and provides the least protection through special designations, but does provide more effective proactive management, including NSO and CSU restrictions, than Alternative A. Alternative A, the existing management, includes the least effective proactive management, in part because of the change in understanding of the adverse impact of viewshed intrusions that has evolved since this management was developed. However, management under Alternative A would result in less resource use than Alternative C, and adverse impacts would likewise be less under this alternative. Alternative D provides protection similar to Alternative B, but

emphasizes viewshed protection that would result in a reduced potential for adverse impact than alternatives A and C, but more than Alternative B.

4.7.4.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Allowable uses and management actions that may impact NHTs and Other Historic Trails include changes in ownership, access, and proactive NHT and Other Historic Trails management actions. Any surface-disturbing activity, regardless of type, on or adjacent to NHTs or Other Historic Trails may cause adverse impacts to contributing segments of the trails. Visual impacts from development, such as windmills, or incompatible use, such as motorized vehicles on intact trails, also are possible.

Recreation and educational uses of the trails under any alternative may have both a beneficial and an adverse impact. Information about the trails may promote preservation, but also may encourage visitation and use, which may degrade trails.

Compliance with NHPA Section 106 is required for all alternatives and all types of activities, resulting in the mitigation of adverse impacts. Although resource avoidance is the preferred mitigation, other solutions may be reached.

Alternative A

Surface Disturbance

Surface-disturbing activities under Alternative A have the potential to impact the Nez Perce NHT and Other Historic Trails. Actions that may physically affect the trails, however, would be limited because of the buffer zone required by existing management plans, and compliance with NHPA Section 106 provides protection from direct impacts. Furthermore, if direct impacts are unavoidable, NHPA compliance requires mitigation of those impacts.

Impacts to the Nez Perce NHT and Other Historic Trails from surface disturbance projected for Alternative A are anticipated to be primarily adverse. However, normal compliance with NHPA Section 106 before approving an action moderates the amount of actual disturbance. When an accommodation cannot be made, the BLM and the SHPO consult to develop and implement a treatment plan to mitigate adverse impacts to contributing segments. While this often results in project relocation, detailed recording and mapping or interpretation are some of the techniques that may be used for mitigation, depending on the specific trail segment and the nature of the potential adverse impacts.

Restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations) under Alternative A provide additional protection for trail resources.

Resource Uses

Actions related to lands and realty actions on BLM-administered surface land can result in both beneficial and adverse impacts to the Nez Perce NHT and Other Historic Trails. The survey that would be required for NHPA Section compliance in the case of either disposal or acquisition would result in a beneficial impact to cultural resources because of data that furthers understanding of trail resources in the Planning Area. If contributing segments were identified during an inventory for disposal of lands, there would be an adverse impact due to a change in the protective measures for cultural resources. If the BLM acquired the land, the impact would be beneficial. Although land-tenure adjustment is classified as an adverse impact (in terms of Section 106), development of a treatment plan for

contributing trail segments would mitigate that impact. The plan would be developed through consultation between the BLM and SHPO in compliance with Section 106 and BLM trail guidance.

Actions regarding linear resources, including ROWs, corridors, renewable energy projects, and recreational trails management may all impact the Nez Perce NHT and Other Historic Trails, not only adversely through direct disturbance of the trail, but indirectly because the routes traveled by trails may also be the best route for these other resource uses. Under Alternative A, the Nez Perce NHT and Other Historic Trails are provided with a maximum buffer from surface disturbance and visual impacts of ¼ mile. Renewable energy is one of the more problematic resource uses, because the infrastructure to exploit solar and wind energy may be highly visible, depending on the terrain, but the buffer to protect the trail viewshed is limited to ¼ mile. Some beneficial impacts may result from inventory and the identification of previously unrecorded segments. In all cases, adverse impacts must be mitigated in compliance with NHPA Section 106.

Travel management and recreation also may result in both direct and indirect, and adverse and beneficial impacts. Where recreational trails match or parallel the Nez Perce NHT and Other Historic Trails, use may degrade the surface of the trail or impact the viewshed from the trail. Improved access also may indirectly lead to impacts. Similarly, construction of trailheads and educational signs and/or kiosks may increase use of the trails and expose them to vandalism. Under all alternatives, motorized vehicle use is anticipated to increase in the Planning Area, bringing greater access and the potential for greater adverse impacts. Concentrated herbivory may adversely affect the Nez Perce NHT and Other Historic Trails. Impacts would be direct, through trampling, and indirect, through reduction in vegetation leading to increased erosion.

Special Designations

Special designations would tend to have beneficial impacts to the Nez Perce NHT and Other Historic Trails. The main exception would be back country byways, which would indirectly and adversely impact historic trails resources through increased access. Beneficial impacts to NHTs and Other Trails are anticipated under Alternative A from special designations.

Resources

The impact of fire and fuels management would be primarily adverse. Because of the unique nature of trails, there is little to distinguish between long- and short-term impacts, because once trail ruts or original markers are disrupted or destroyed, they cannot be restored. Use of a trail corridor to access a fire location for suppression, stabilization and rehabilitation, and creation of fire breaks, can all result in direct, adverse impacts. Approximately 70,000 acres of short-term disturbance from fire and fuels management are anticipated under Alternative A (Appendix T).

Cultural resources and VRM would both have direct and indirect beneficial impacts to the Nez Perce NHT and Other Historic Trails. Because management of both these resources overlaps with management of historic trails, the trails would benefit from protections and proactive activities for these other resources.

Proactive Management

Proactive management actions under Alternative A generally result in beneficial impacts to the Nez Perce NHT and Other Historic Trails. Under existing management, an NSO stipulation is applied within ¼ mile of the Nez Perce NHT and Other Historic Trails. Because trails often comprise multiple traces, the ¼-mile buffer zone extends from the outer edges of the overall trace. Current management also avoids

surface-disturbing activities in view within ¼ mile of both the Nez Perce NHT and significant segments of Other Historic Trails, including the Bridger Trail and Fort Washakie to Meeteetse to Red Lodge Trail.

Alternative B

Surface Disturbance

Surface disturbance affects the fewest acres under Alternative B, and thus has the least direct impact on the Nez Perce NHT and Other Historic Trails compared to alternatives A, C, and D. As with Alternative A, actions that may physically impact the trails, particularly the Nez Perce NHT, would be limited through enforcement of a buffer zone. Under this alternative, the buffer zone would extend to in view within 5 miles of the Nez Perce NHT and Other Historic Trails, except within existing utility corridors. Additional protections come from an NSO restriction within 3 miles and a CSU stipulation in view within 5 miles of the Nez Perce NHT and Other Historic Trails. The same distances apply to mineral materials disposal.

As with the other alternatives, normal compliance with NHPA Section 106 before approving an action moderates the amount of actual disturbance. In addition, the BLM and the SHPO consult to develop and implement a treatment plan to mitigate adverse impacts to contributing trail segments.

Restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations) are greatest under Alternative B, providing more protection for trail resources than under alternatives A, C and D.

Resource Uses

Impacts related to lands and realty actions on BLM-administered surface land are anticipated to be similar to those for Alternative A; however the intensity varies by alternative. Compliance with the NHPA would still be required. More acreage may be acquired under Alternative B than under alternatives A, C or D, with the result that there would be more survey and identification of potentially NRHP-eligible trail segments than under alternatives A, C or D.

Management of linear resource uses (e.g., ROWs, corridors, renewable energy projects, and travel and trails management) would result in similar, but of a reduced magnitude impacts, than under Alternative A. Alternative B provides a wider buffer zone than alternatives A, C, or D, and limits ROW authorizations within 5 miles for the Nez Perce NHT and Other Historic Trails (except within existing utility corridors). As with the other alternatives, renewable energy presents a special situation. Even the wider buffer zone required under Alternative B may need to be expanded as the trails' viewsheds are considered on a case-by-case basis, depending on the terrain. In all cases, adverse impacts must be mitigated in compliance with NHPA Section 106.

Alternative B provides for more recreational options and more anticipated disturbance than Alternative A. Improved access also may indirectly lead to impacts. Livestock grazing under Alternative B would result in impacts similar to Alternative A, although more areas may be placed off limits to grazing based on site-specific environmental analysis, providing greater protection to the Nez Perce NHT and Other Historic Trails.

Special Designations

Alternative B designates more special designation areas and includes greater restrictions on surface-disturbing activity within these areas than alternatives A, C and D. These additional restrictions would result in the greatest beneficial impact to NHTs and Other Historic Trails. However, Alternative B also designates more back country byways than alternatives A, C, and D and develops more interpretative

facilities than the other alternatives, which may increase adverse impacts through increased access. Adverse and beneficial impacts would be greatest under Alternative B.

Resources

The impact of fire and fuels management would be primarily adverse under Alternative B, but would have the least impact compared to the other alternatives due to the smallest projected acreage of related disturbance.

Alternative B provides more protection for cultural and visual resources than alternatives A, C, or D, resulting in greater beneficial impacts to NHTs and Other Historic Trails. For example, Alternative B manages more of the Planning Area as VRM Class I and II, which would close or limit motorized vehicle use to designated roads and trails.

Proactive Management

Proactive management actions under Alternative B emphasize resource protection in the vicinity of the Nez Perce NHT and Other Historic Trails through a 3-mile NSO and 5-mile CSU buffer, and viewshed buffers. In addition, this alternative allows wider buffers on a case-by-case basis for certain types of development, such as wind-energy developments. Use of motorized vehicles also is limited to designated roads and trails in view within 5 miles of trails. Because trails often comprise multiple traces, the buffer zones extend from the outer edges of the overall trace. These buffer zones are larger under Alternative B than the other alternatives. Alternative B removes canals from the same type of consideration as trails, recognizing that the significance criteria for this resource type are different from those of other linear features, such as trails.

Alternative C

Surface Disturbance

Alternative C is projected to result in the greatest acreage of surface disturbance and, consequently, the greatest potential to NHT and Other Historic Trails. As with the other alternatives, compliance with BLM management practices and the NHPA would limit adverse impacts through development of treatment plans and adherence to buffer zones.

Because management under Alternative C places a greater emphasis on resource use, there would be fewer restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations). Therefore, although there would be some additional protection for trail resources, it would be less than under alternatives A, B, or D.

Resource Uses

The Nez Perce NHT and Other Historic Trails would be affected by lands and realty management similar to Alternative A. As under the other alternatives, the survey required for NHPA Section 106 compliance in the case of either disposal or acquisition would result in a beneficial impact to cultural resources because of data that furthers understanding of trail resources in the Planning Area. Less acreage is available for acquisition under this alternative than under alternatives A, B, and D, with the result that there would be less survey and identification of potentially NRHP-eligible trail segments than under the other alternatives.

Under Alternative C, the management of linear resource uses (e.g., ROWs, corridors, renewable energy projects, and recreational trails management) would have greater impacts on the Nez Perce NHT and Other Historic Trails than actions under alternatives A, B, or D. Under this alternative, an NSO restriction

is applied, similar to Alternative A, but a 1-mile CSU stipulation is also added to protect the Nez Perce NHT. The areas around the Nez Perce NHT are closed to mineral materials disposal within ¼ mile or in view within 1 mile, and motorized travel is limited to designated roads and trails in view within ¼ mile. Similar restrictions are applied to Other Historic Trails, except within existing utility corridors where the trail lacks integrity or the viewshed has been compromised. Some beneficial impacts would result from the inventory and identification of previously unrecorded segments. In all cases, adverse impacts must be mitigated in compliance with NHPA Section 106.

Improved access, due to fewer limitations on motorized vehicle use, has the greatest potential to result in indirect adverse impacts under this alternative. Similarly, recreational development is greatest under this alternative, potentially leading to the greatest adverse impacts. However, installation of educational kiosks, diversion of traffic away from the historic trail to alternative routes, and general improved education would have a beneficial impact.

Special Designations

Beneficial impacts from special designations would be lowest under Alternative C. Having fewer special designations and, fewer restrictions within those areas would reduce the benefits to NHTs and Other Historic Trails. Back country byways, which may indirectly affect historic trails resources through increased access, are managed similar to Alternative A.

Resources

As under the other alternatives, impacts from fire and fuels management would be primarily adverse. A greater emphasis on commodity production would increase the potential for adverse impacts. Alternative C would cause the most disturbance related to fire and fuels management compared to alternatives A, B, and D.

Under Alternative C, cultural and visual resources management would continue to result in both direct and indirect beneficial impacts to the Nez Perce NHT and Other Historic Trails, although the impacts would be less than under alternatives B and D. For example, motorized vehicle use is not limited by VRM class under Alternative C, whereas Alternative B restricts motorized vehicle use in these areas.

Proactive Management

Proactive management actions under Alternative C would result in beneficial impacts to the Nez Perce NHT and Other Historic Trails. Under existing management, an NSO restriction is added within ¼ mile of the Nez Perce NHT and Other Historic Trails, and a CSU restriction is added within 1 mile of the Nez Perce NHT and Other Historic Trails. Exceptions occur where the trail's integrity or setting has been compromised. Areas within ¼ mile or in view within 1 mile also are closed to mineral materials disposal, and motorized vehicle use is limited to designated roads and trails, which would reduce access and associated impacts. As with the other alternatives, because NHT and Other Historic Trails often comprise multiple traces, the buffer zones extend from the outer edges of the overall trace. The buffer zones and restrictions under Alternative C are less than those required under alternatives B and D, but more than under Alternative A.

Alternative D

Surface Disturbance

The amount of surface disturbance projected under Alternative D is similar to Alternative A, falling between the amount of disturbance projected under alternatives B and C. As with Alternative A, actions that would directly affect these trails, particularly the Nez Perce NHT, would be limited due to buffer

zones that restrict certain resource uses. In contrast to the other alternatives, Alternative D does not contain management specific to mineral leasing (e.g., NSO or CSU restrictions) or mineral materials disposal, instead controlling these uses through a more generalized management approach to mitigate their impacts. Under this alternative, the BLM avoids surface-disturbing activities and protects the foreground of the trails up to 3 miles where setting is an important aspect of the integrity of the trail, and uses BMPs to avoid or mitigate adverse impacts.

As with the other alternatives, required compliance with NHPA Section 106 before approving an action would reduce disturbance or adverse impacts to these trails. Additionally, the BLM and the SHPO consult to develop and implement a treatment plan to mitigate adverse impacts to contributing trail segments.

Restrictions on surface-disturbing activities for the protection of other resources (e.g., soil, water, biological resources, and special designations) under Alternative D would result in impacts similar to Alternative A.

Resource Uses

The types of impacts from lands and realty management are anticipated to be similar to those described under Alternative A, though the intensity of these impacts would be less than under alternatives A or C, and more than under Alternative B. In all cases, compliance with the NHPA is still required.

The management of linear resource uses (e.g., ROWs, corridors, renewable energy projects, and travel and trails management) would result in fewer adverse impacts than Alternative A. Alternative D provides protection via a wider buffer zone than either alternative A or C, but less than Alternative B. For Other Historic Trails, motorized vehicle use is constrained or guided by other resource management actions and does not have trails-specific requirements, in contrast to alternatives B and C. As with the other alternatives, renewable energy presents a special situation, whereby the trails' viewsheds are considered on a case-by-case basis, depending on the terrain. In all cases, adverse impacts must be mitigated in compliance with NHPA Section 106.

For other resource uses, including recreation and livestock grazing, impacts from management under Alternative D would be similar to those under Alternative A.

Special Designations

Alternative D designates more special designation areas and includes greater restrictions on surface-disturbing activity within these areas, resulting in a greater beneficial impact than alternatives A and C. In all cases, improved access also may indirectly lead to impacts. Although Alternative D has fewer back country byways than Alternative B, it has more than alternatives A and C, and may increase access to historic trails in the vicinity of the byways.

Resources

The impact of fire and fuels management would be similar to that under Alternative A. Alternative D protects cultural and visual resources somewhat less than Alternative B, but more than either alternative A or C, resulting in beneficial impacts to NHTs and Other Historic Trails.

Proactive Management

Proactive management actions under Alternative D emphasize avoidance of surface-disturbing activities and protection of the foreground of the Nez Perce NHT and Other Historic Trails. For the Nez Perce NHT, Alternative D requires the avoidance of surface-disturbing activity up to 3 miles where setting is an important aspect of the integrity for the trail. BMPs are to be used to avoid or mitigate adverse effects

for the Nez Perce NHT and all Historic Trail segments. Motorized vehicle use is limited to existing roads and trails within 5 miles of the Nez Perce NHT. For Other Historic Trails, the foreground is to be protected up to 2 miles, and motorized vehicle use is constrained or guided by other resource management actions. In addition, consideration of wider buffers may be necessary on a case-by-case basis for certain types of development, such as wind-energy developments. Because trails often comprise multiple traces, the buffer zone extends from the outer edges of the overall trace. These buffer zones are larger under Alternative D than alternatives A and C, but smaller than Alternative B.

4.7.5 Wild and Scenic Rivers

There are 20 waterways and associated waterway corridors (comprising 26,742 acres) in the Planning Area that have been identified as eligible for inclusion in the NWSRS due to their ORVs and free-flowing characteristics. Chapter 3 and Appendix F describe the process used to identify WSR eligible waterways (WSR eligible waterway segments) and lists the ORVs, preliminary designations (wild, scenic, or recreational), and suitability determinations for each.

This section describes proposed management actions for WSR eligible waterway segments likely to result in impacts to other resources, resource uses, and special designations. This section also describes the effects of management actions on the ORVs and other WSR-related qualities identified in these areas (i.e., their free-flowing nature and the characteristics that justified their tentative classifications).

Adverse impacts from management of WSR eligible waterways result from actions that restrict resource uses or the management of resources; beneficial impacts are those that enhance other resource uses or the management of resources. Adverse impacts to WSR eligible waterways are those that diminish free-flowing characteristics, ORVs, and characteristics that justified their tentative classifications as wild, scenic, or recreational waterways; beneficial impacts are those that preserve and enhance these qualities. ORVs include scenic, recreational, geologic, fish, wildlife, cultural, historic, and other similar values (e.g., ecologic/biologic diversity, paleontological, or botanic values). Adverse impacts to ORVs generally result from surface-disturbing activities (such as mineral development, ROW and road construction, and vegetation treatment and timber harvesting) or other activities that can affect vegetation or damage resources, such as concentrated livestock grazing and off-road motorized vehicle use.

Direct impacts result from management actions prescribed to WSR eligible waterway segments that restrict other resource uses or activities. Direct impacts also result from resource uses or activities (or restrictions thereof) within WSR eligible waterway corridors that affect their tentative classifications. Indirect impacts include management actions prescribed to overlapping special designations (e.g., WSAs) that may contribute to the preservation of free-flowing characteristics, ORVs, and characteristics that justified their tentative classifications.

4.7.5.1 Methods and Assumptions

Methods and assumptions used in this impact analysis include the following:

- Alternative A assumes the BLM continues the current interim management for the 20 eligible waterways.
- Alternative B assumes that all 20 eligible waterways are recommended to Congress, and subsequently accepted, as suitable for inclusion in the NWSRs.
- Alternatives C and D assume that the BLM recommends none of the eligible waterways to Congress as suitable for inclusion in the NWSRS.

- Interim Management of WSRs may not be consistent with other resource values.
- Designating rivers as WSRs may attract more visitors to the area, and therefore, increase resource use.

4.7.5.2 Summary of Impacts by Alternative

Alternatives A and B apply interim management to the 20 eligible waterway segments and associated waterway corridors to preserve their free-flowing characteristics, ORVs, and characteristics that justified their tentative classifications; Alternative B also recommends all of these waterways to Congress as suitable for inclusion the NWSRS. In contrast, under alternatives C and D, the BLM does not recommend any of these eligible waterways to Congress as suitable for inclusion in the NWSRS and therefore does not apply interim management to preserve their ORVs and free-flowing characteristics. The preservation of any ORVs or other WSR-related qualities identified in the waterway segments would be least effective under alternatives C and D due to the greater intensity of resource uses allowed under these alternatives. Alternatives B and A, respectively, are the most protective of WSR eligible waterway segments and would result in the greatest beneficial impacts to the free-flowing characteristics, ORVs, and characteristics that justified their tentative classifications as wild, scenic, or recreational waterways by restricting or limiting resource uses that could degrade these qualities. Due to the extent and intensity of the restrictions under Alternative B, the beneficial impacts to the WSR-related qualities and the adverse impacts to other activities and resource uses would be greatest under this alternative. Alternatives C and D, respectively, include the least restrictive management of several resource uses and would have the fewest adverse impacts on mineral development, livestock grazing, and timber harvesting.

4.7.5.3 Detailed Analysis of Alternatives

Waterway segments are only recommended for inclusion in the NWSRS or managed to preserve ORVs and the free-flowing characteristics under alternatives A and B. Under alternatives C and D, no waterways in the Planning Area are recommended for inclusion in the NWSRS or managed for the purpose of protecting any WSR-related qualities or characteristics.

Table 4-19 summarizes acreages and allocations associated with resources and resource uses along the waterway segments managed under alternatives A and B. For purposes of comparison, this table also lists the acreages and allocations of these same waterway segments under alternatives C and D; no special management actions are specifically applied to protect the ORVs and other WSR-related qualities under these alternatives.

Table 4-19. Acres of Management in Wild and Scenic River Eligible and/or Suitable Segments by Alternative

	Mineral Development Restrictions (acres)			Rights-of-Way (acres)			Visual Resource Management (acres)				Travel Management (acres)				
	Mineral Materials Closure	Administratively Unavailable for Mineral Leasing	Withdrawn from Mineral Entry	Exclusion	Avoidance/Mitigation	Open	Class I	Class II	Class III	Class IV	Closed	Limited to Designated	Limited to Existing	Open	Seasonal Restrictions
Alternative A	21,221	14,002	19,497	10,564	15,301	876	5,003	18,020	1,458	2,240	3,436	18,646	3,954	0	705
Alternative B	25,252	26,742	26,742	26,742	0	0	18,134	8,424	0	183	21,391	4,163	0	0	1,187
Alternative C	8,416	7,451	8,416	0	15,489	11,253	5,003	17,399	1,692	2,647	5,538	12,703	5,930	0	2,572
Alternative D	5,085	13,718	8,364	0	26,742	0	5,003	29,855	699	183	4,390	16,734	3,747	0	1,871

Source: BLM 2009a

Impacts Common to All Alternatives

The only management common to all the alternatives is the closure of eligible and suitable waterway segments to disposal actions, which would result in an adverse impact to lands and realty by prohibiting land disposals along the waterway corridors identified in Chapter 3. Prohibiting disposals in these areas may result in beneficial impacts to WSR eligible and suitable waterway segments by preventing the disposal of land that could subsequently be used in a manner that diminishes ORVs.

There is no other "common-to-all management" specific to WSR eligible and/or suitable waterway segments. However, any management that results in restrictions on resource use, development, or surface-disturbing activities near to WSR segments may result in beneficial impacts by reducing the potential for impacts on ORVs or the free-flowing or other characteristics of these waterways. Alternatively, management that decreases restrictions in areas near these waterway segments may result in adverse impacts by diminishing ORVs and other characteristics of the waterways.

Alternative A

Under Alternative A, the BLM has identified 20 WSR eligible waterway segments (see Chapter 3) and applies interim management to protect their free-flowing characteristics and ORVs. Under interim management, the qualities that preliminarily qualified the waterway segments as eligible for inclusion in the NWSRS are protected, and the undeveloped nature of the waterways is preserved.

Surface Disturbance

Under Alternative A, surface-disturbing and disruptive activities are allowed on a case-by-case basis along nine WSR eligible waterways and portions of the Clarks Fork of the Yellowstone River and White Creek, while such activities are prohibited along the other eligible waterways. Prohibitions against surface disturbance would result in adverse impacts to mineral development, range improvement projects, watershed improvement projects, recreation development, and other types of actions that benefit these resources and resource uses, while case-by-case reviews may result in additional expense and delays for these types of actions. Prohibitions on and, to a lesser degree, case-by-case reviews of surface-disturbing activities would generally result in beneficial impacts to the ORVs and other WSR-related qualities along the eligible waterway segments because activities that degrade these qualities are not allowed.

Under this alternative, the BLM performs a case-by-case review of all proposed actions along all WSR eligible waterways and applies protective management, subject to existing rights, as appropriate. Case-by-case reviews may result in additional expense and delay for some projects, but requiring reviews of all these actions may result in additional mitigation or design considerations that protect the ORVs and other WSR-related qualities of the waterways.

Resource Uses

Management for eligible WSR segments under Alternative A is designed to preserve their ORVs and other WSR-related qualities, but also imposes restrictions that would adversely affect other resources and resource uses. Restrictions on mineral entry, leasing, and disposal under this alternative would result in adverse impacts to mineral resources. Under Alternative A, nine WSR eligible waterways are withdrawn (or partially withdrawn in the cases of Porcupine, Dry Medicine Lodge, and White creeks) from appropriation under the mining laws and administratively unavailable for mineral leasing. Along seven WSR eligible water segments, including portions on the Paint Rock Creek Unit and Clarks Fork of the Yellowstone River, this alternative applies an NSO restriction and a seasonal NSO restriction (in the

WFO only) on mineral leasing. Alternative A also limits geophysical exploration along 11 WSR eligible waterway segments, including portions of White Creek and Clarks Fork of the Yellowstone River, to foot access and allows geophysical exploration via existing roads and trails along three other segments. Management under this alternative closes 12 WSR eligible waterway segments, including portions of White Creek and Clarks Fork of the Yellowstone River, to recreational dredging for minerals and mineral materials disposal. Closing the majority of the WSR eligible waterway corridors to mineral entry, leasing, and disposal and applying additional restrictions on exploration and surface occupancy in the remaining areas would result in adverse impacts to mineral resources (see Table 4-19). Restrictions on mineral exploration and development in these areas would reduce adverse impacts to vegetation, wildlife, cultural, and scenic quality-related ORVs.

Closing 13 eligible and suitable WSR waterways, including portions of White Creek and Clarks Fork of the Yellowstone River, to timber sale or harvesting would result in adverse impacts to forest products and beneficial impacts to these WSR eligible waterways ORVs. Adverse impacts to the use of forest products would result from these restrictions on forest management practices and the extraction of forest products. Closure to timber sale or harvesting would result in beneficial impacts to the protection of ORVs if these closures prevent surface-disturbing activities, habitat loss, damage to cultural resources, degradation of scenic quality, or other ORVs along these waterway segments.

Under Alternative A, the BLM manages four WSR eligible waterways, (including a portion of White Creek), as ROW exclusion areas, nine as ROW avoidance/mitigation areas (including portions on the Paint Rock Creek Unit and Clarks Fork of the Yellowstone River), and the remainder as open to ROW authorizations subject to case-by-case approval. Management that restricts the ability to grant ROW authorizations would result in adverse impacts to ROW authorizations. Impacts from restrictions on ROW authorizations would be most severe in ROW exclusion areas.

Under Alternative A, five WSR eligible waterway corridors are closed to motorized vehicle use and the use of motorized or mechanized vehicle ground equipment to suppress fires (including a portion of White Creek); nine are limited to designated roads and trails (including a portion of Clarks Fork of the Yellowstone River); and the remainder are limited to existing roads and trails. Travel management that restricts motorized vehicle use, particularly through closures or limiting travel to designated routes, would result in adverse impacts to access and recreational motorized travel by eliminating some potential routes.

Alternative A includes management for WSR eligible waterway corridors to prevent an increase in actual grazing use, which may result in adverse impacts to livestock grazing and beneficial impacts to waterway ORVs. Adverse impacts to livestock grazing may result if additional forage becomes available in the WSR eligible waterway corridors and it cannot be allocated to grazing permittees. Beneficial impacts from limiting the amount of grazing use to current levels may include a smaller risk of damage to the ORVs that are vulnerable to invasive species (i.e., scenic, wildlife, and other vegetation-related values) and, in situations where livestock grazing could become concentrated if additional use is allowed, less soil compaction and degradation of riparian/wetland areas.

Special Designations

WSR eligible waterways, where they intersect specially designated areas with additional and more restrictive management, such as WSAs, would be afforded additional protection. In the case of WSAs, Class I VRM objectives and non-impairment standards as directed from the *Interim Management Policy and Guidelines for Lands Under Wilderness Review: Update Document H-8550* would benefit the ORVs and the free-flowing character of the waterways and other resources within these corridors, including wildlife, vegetation, soils, watershed, and recreational settings and experiences. However, these

additional management prescriptions may preclude other resource management actions that may benefit those resources, for example, watershed development projects and wildlife development projects such as fish barriers.

Resources

Prohibitions on water impoundments, major diversions, or hydroelectric power facilities on all WSR eligible waterways under Alternative A would result in adverse impacts to water development projects and beneficial impacts to the protection of the free-flowing nature of the waterways.

Managing the corridors along two WSR eligible waterway segments as VRM Class IV and 12 segments (including portions on the Paint Rock Creek Unit, White Creek, and Clarks Fork of the Yellowstone River) as VRM Class II would result in adverse impacts to resource uses and development, but would benefit certain ORVs (see Table 4-19). Along WSR eligible waterway segments where there is no WSR-specific VRM, visual resources are managed consistent with the underlying VRM classification in consideration of the need to avoid damaging the identified ORVs. Managing visual resources as VRM Class II would restrict the development and use of other resources because the allowable visual contrast would be limited and additional design consideration or mitigation may be required for certain activities. Management under stricter VRM Classes (i.e., Classes I and II) would be beneficial to the protection of scenic, recreational, and other ORVs that may be affected by surface-disturbing and other related activities. WSR eligible waterways are managed as VRM Class I where they intersect WSAs.

Alternative B

Under Alternative B, the BLM recommends to Congress that all 20 waterway segments indentified as WSR eligible in Alternative A are suitable for inclusion in the NWSRS (see Chapter 3). To support this recommendation, the BLM applies specific management prescriptions to protect and enhance their free-flowing characteristics, ORVs, and other wild, scenic, or recreational characteristics.

Surface Disturbance

Under Alternative B, surface-disturbing and disruptive activities are prohibited along all the WSR suitable segments and impacts would be similar to, but more extensive than, those under Alternative A. Closing lands along the Middle Fork of the Powder River, Paint Rock Creek Unit, and Dry Medicine Lodge Creek and other additional waterways under this alternative would provide only minimal added protection, because the case-by-case authorization of surface-disturbing activities under Alternative A would be used to protect the free-flowing nature and ORVs associated with these waterways.

Where appropriate, Alternative B applies protective management based on case-by-case reviews of discretionary actions proposed in the waterway corridors. Generally, the BLM would not approve such actions if they could result in adverse impacts to a WSR suitable waterways free-flowing nature and ORVs.

Resource Uses

Impacts to and from mineral development and timber harvesting under Alternative B would be similar to Alternative A, except that the extent would be greater because more areas are closed to these activities (Table 4-19). All WSR suitable waterway segments would be withdrawn from appropriations under the mining laws and administratively unavailable for mineral leasing. Unlike Alternative A, Alternative B also would close all segments to geophysical exploration. The management of mineral materials disposal would be the same as under Alternative A, though restrictions to protect other resources would mean more area along suitable waterways would be closed to disposals than under

Alternative A. Alternative B also closes all WSR suitable waterway corridors to timber sale or harvesting. Management of minerals and forest products under this alternative would be more effective at protecting and enhancing the ORVs than Alternative A, and would be more effective at preserving the tentative classification of these waterways, especially along Wild and Scenic waterways where watersheds and shorelines are to be maintained in a primitive or largely undeveloped state, respectively.

The BLM manages all WSR suitable waterway corridors as ROW exclusion areas and closes the majority to motorized vehicle use (see Table 4-19). Impacts of ROW management would be similar to those described for Alternative A, although to a greater extent because managing the WSR suitable waterways as ROW exclusion would prohibit ROW authorizations, even if effects on ORVs could be mitigated. Adverse impacts from travel and transportation management designations in along WSR suitable waterways under Alternative B would result in impacts similar to Alternative A, but to a greater extent because of increased restrictions that close or limit travel to designated roads and trails across a larger area. Similar to the beneficial impacts conveyed through more restrictive management of mineral use and forest products, the management of ROWs and CTTM under this alternative would be more effective at maintaining and enhancing the ORVs and tentative classifications of the waterways than management under Alternative A.

Under Alternative B, all WSR suitable waterway corridors would be closed to livestock grazing, and adverse impacts to this resource use would be greater than under Alternative A. Closing these areas to livestock grazing would remove AUMs associated with available forage and would result in reduced flexibility and increased operating costs for livestock grazing permittees in affected allotments. Although no conflicts between livestock grazing and the waterway segment ORVs have been identified, a closure may protect against future visual intrusions and impacts to vegetation and soils (e.g., invasive species infestations or damage to riparian/wetland vegetation) that could degrade certain ORVs.

Special Designations

WSR suitable waterways that intersect special designation areas with more restrictive management of resource uses would be afforded additional protection. WSRs, which are managed as VRM Class I to maintain their scenic qualities, would indirectly beneficially affect other resources, such as recreational settings and experiences and wildlife resources and associated habitat on WSR suitable waterways.

Resources

Management of water impoundments, major diversions, or hydroelectric power facilities would be the same as under Alternative A.

Under Alternative B, one WSR suitable waterway segment is managed as VRM Class IV, and the remainder are managed as VRM Class I (11 waterways) or Class II (8 waterways) (see Table 4-19). This management would be more restrictive than management under Alternative A and would effectively limit the types of visual intrusions along the WSR suitable waterways to only very minor activities that would not attract the attention of viewers. This more restrictive management would allow more effective maintenance of these waterways, tentative classifications and would provide additional protection and enhancement of scenic, recreational, and other ORVs that may be affected by surface-disturbing and other related activities compared to Alternative A. Where WSR suitable waterways intersect WSAs, other resource enhancement projects, such as the construction of fish barriers, may be precluded.

Alternative C

Under Alternative C, none of the waterway segments determined to be WSR eligible under Alternative A would be recommend to Congress as suitable, and the impacts to resources and resource uses under alternatives A and B would not occur. These waterway segments are released to other uses and no special management actions are specifically applied to protect the ORVs. Alternative C allows activities that may alter the ORVs identified under Alternative A, depending on restrictions from other program areas.

The BLM would manage the sale and harvest of forest products consistent with other management objectives. This alternative implements the greatest amount of silviculture treatments to actively manage the forests and woodlands and would be less restrictive to the harvest of forest products than the other alternatives. These activities would increase the potential for adverse impacts to the ORVs and other WSR-related values of these waterways.

Alternative C generally includes the fewest restrictions on mineral exploration and development of any alternative and would result in the fewest impacts on minerals development of any alternative, and the largest adverse impacts to the ORVs and other WSR-related values (see Table 4-19).

Under Alternative C, management of ROW authorizations, VRM, and travel is similar but slightly less restrictive than under Alternative A (see Table 4-19) and impacts would generally be similar to those described for that alternative. Alternative C manages a greater area as open or avoidance/mitigation areas for ROW than Alternative A. Alternative C ROW management would result in fewer adverse impacts to the location of ROWs, but greater adverse impacts to ORVs from more ROWs and fewer requirements for mitigation of these adverse impacts. Alternative C closes more acreage to motorized vehicle use than Alternative A and permits motorized vehicle use across a slightly smaller area on existing and designated roads and trails, which may result in a smaller potential for adverse impacts to the preservation of ORVs and other WSR-related qualities from motorized public access. Alternative C would not encourage new recreation opportunities on these waterways to the same degree as alternatives A and B.

Alternative C generally places the fewest restrictions on livestock grazing management and livestock forage production and utilization, and would be least restrictive to livestock grazing management in the waterway segments than the other alternatives. This would minimize the realization of beneficial impacts described for Alternative B.

Some of these waterway segments will remain protected under the management prescriptions of other resource programs such as ACECs and WSAs. However, these prescriptions may be eliminated if Congress decides to release the WSAs within these areas to multiple uses or the BLM does not carry forward these ACECs in future RMP revisions, at which time the waterway segments would lose any protective management prescriptions associated with these designations. Lack of these prescriptions would adversely affect the identified ORVs within the segments, as well as other resources such as wildlife, fisheries, scenic quality, and recreational resources that benefit from these management prescriptions.

Alternative D

Under Alternative D, none of the waterway segments determined to be WSR eligible under Alternative A would be recommend to Congress as suitable, and the impacts to resources and resource uses under alternatives A and B would not occur. As under Alternative C, no special management actions are applied to protect the ORVs. Alternative D allows activities that may alter the ORVs identified under Alternative A, depending on restrictions from other program areas.

Mineral exploration and development under Alternative D is similar to management under Alternative C, and would result in similar types of impacts to the identified ORVs and other WSR-related values (see Table 4-19).

The BLM would manage the sale and harvest of forest products consistent with other management objectives, and the impacts of this alternative on the identified ORVs would be similar to those described for Alternative C. Both the adverse and beneficial impacts from this management would occur to a lesser extent under Alternative D, because fewer acres would be available and timber harvests and treatments would be managed for resource protection and enhancement, in addition to enhancing resource uses.

Under Alternative D, management of ROW authorizations, VRM, and travel is similar to Alternative A (see Table 4-19) and impacts would generally be similar to those identified under that alternative. Alternative D limits motorized vehicles to designated roads and trails on a similar acreage as Alternative A, and manages more area as closed to motorized use than alternatives A and C, but substantially less than Alternative B. In addition, Alternative D manages more acreage as ROW avoidance/mitigation areas than Alternative C, which may reduce adverse impacts to the ORVs and other WSR-related qualities compared to that alternative by giving the BLM more ability to control ROW siting, apply additional mitigation, and close routes that are causing environmental damage. New recreation opportunities would be encouraged similarly to Alternative C.

Alternative D places restrictions on livestock grazing management and livestock forage production and utilization similar to those under Alternative A. However, under Alternative D, these waterways would not be managed to prevent an increase in actual grazing use and the adverse impacts to livestock grazing and beneficial impacts to the ORVs would not occur.

Similar to Alternative C, some of these waterway segments ORVs would be protected under the management prescriptions of other resource programs, such as ACECs and WSAs. The protections from these special designations would be greater under this alternative however, as Alternative D includes a greater number of ACECs than alternatives A or C, but fewer than Alternative B. As described under Alternative C, these protective management prescriptions would not remain in effective if the WSAs or ACEC overlapping the waterway segment were released.

4.7.6 Wilderness Study Areas

WSAs are managed under the *Interim Management Policy and Guidelines for Lands Under Wilderness Review: Update Document H-8550*. Most management actions and resource uses in WSAs are subject to the nonimpairment mandate under the IMP, ensuring that WSAs are not adversely affected by impairing their suitability for preservation as wilderness. There are no proposed actions contrary to managing the areas to protect their wilderness characteristics. Therefore, managing WSAs under the IMP preserves the wilderness character of the areas. The areas' naturalness, opportunities for solitude and primitive, unconfined recreation, and any special features that further qualify them for consideration as wilderness, would be preserved. At the same time, activities that would adversely affect the wilderness character of the areas would be prohibited.

Adverse impacts to WSAs are those that reduce wilderness characteristics in the area and reduce the potential for designation as wilderness. Beneficial impacts to WSAs are those that maintain or enhance wilderness characteristics or decrease evidence of human presence in these areas. Direct impacts result from management actions that may affect naturalness, opportunities for solitude, and opportunities for primitive, unconfined recreation within the boundaries of WSAs. Indirect impacts include management actions outside WSA boundaries that may affect wilderness characteristics.

4.7.6.1 Methods and Assumptions

Methods and assumptions used in the impact analysis include the following:

- All WSAs in the Planning Area will continue to be managed under the IMP, until such time as Congress either designates all or portions of the WSAs as wilderness or releases the WSAs, or portions of the WSAs, from any further consideration for wilderness and the lands revert back to general land use management.
- Wilderness interim management is subject to valid existing rights and the grandfather clause under all of the alternatives.
- The WSA designation is beneficial to the protection of air and watersheds, soil and water quality, ecological stability, plant and animal gene pools, archeological and historical sites, habitats for wildlife, and livestock grazing.

4.7.6.2 Summary of Impacts by Alternative

WSAs exist under all alternatives and are managed under the IMP, which restricts discretionary activities in WSAs to ensure that their suitability for Wilderness designation is not impaired. Overall, beneficial impacts to WSAs would be the greatest under Alternative B, followed by alternatives D, A, and C. Although there are limited discretionary actions the BLM can take that would affect WSAs, management under Alternative B would result in the greatest beneficial impacts to WSAs by emphasizing resource protection and limiting the potential for activities in and adjacent to WSAs that may adversely affect wilderness characteristics. Alternative C places the fewest restrictions on activities that may diminish wilderness characteristics, and includes the fewest other resource protection measures that would benefit WSAs. Motorized vehicle use, which may be incompatible with the concept of primitive recreation and may affect perceptions of solitude, is least restricted in WSAs under Alternative C, followed by alternatives A, D, and B respectively. Alternatives B, C, and D identify land-tenure adjustment zones that may result in beneficial impacts to WSAs by increasing the potential for and expediting the disposal of inholdings or the acquisition of areas with high wilderness characteristics values that increase the manageability of WSAs. Additionally, alternatives B and D include provisions for the acquisition of inholdings within WSA boundaries that would result in beneficial impacts through the elimination of incompatible uses.

4.7.6.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

The IMP allows for little flexibility in the management of a WSA, because no discretionary actions that adversely affect WSAs are allowed (according to the nonimpairment mandate). The IMP prohibits surface-disturbing and most other disruptive activities and sets management guidelines aimed at the preservation of wilderness characteristics. However, the IMP respects valid existing rights and includes a grandfather clause that allows several resource uses and management actions not subject to the nonimpairment mandate. Resource uses and management actions that may meet this definition, and potentially adversely affect WSAs, include mineral development; ROW maintenance and development and new temporary ROWs where there is no reasonable, less impairing, alternative access available; or valid existing rights where the BLM has determined that application of the nonimpairment standard would unreasonably interfere with the exercise of those rights.

Valid existing mining claims not subject to the nonimpairment mandate may adversely affect wilderness characteristics, primarily through surface disturbance and facilities development. WSAs are closed to

mineral leasing and mineral materials disposal under all alternatives, protecting wilderness values from adverse impacts from new mineral leasing. Existing ROW maintenance requiring vehicle use and new ROW authorizations necessary to develop valid existing rights may adversely affect wilderness characteristics in WSAs through surface disturbance and facilities development.

Invasive species are anticipated to spread under all alternatives and may adversely affect the naturalness of WSAs. Invasive species control is permitted in WSAs under the IMP. Vegetation treatments to control the spread of invasive species may result in short-term adverse impacts to wilderness characteristics due to mechanical clearing, prescribed fire, or other treatments that disturb the naturalness of WSAs. However, invasive species control would result in long-term beneficial impacts by maintaining natural vegetative communities and helping to meet vegetation management objectives.

Other special designations in WSAs, such as ACECs and WSRs, may be beneficial to wilderness characteristics in WSAs if their management increases resource restrictions or actions that protect or increase wilderness characteristics in the WSA. The Spanish Point Karst ACEC, designated under all alternatives, would provide additional protection for cave and karst resources in the Trapper Creek and Medicine Lodge WSAs.

WSAs are managed as VRM Class I areas under all of the alternatives, which is beneficial to the maintenance of wilderness characteristics because VRM Class I areas are managed to preserve the existing character of the landscape. However, activities that alter the visual landscape are allowed in areas adjacent to WSAs if they conform to the VRM for the area.

While the types of impacts to WSAs under each alternative are similar, the magnitude of these impacts would vary based on specific management and allocations under each alternative.

Alternative A

Restrictions on motorized vehicle use in WSAs would provide beneficial impacts to the preservation of wilderness characteristics. Motorized vehicle use may be incompatible with the concept of primitive recreation, and may affect perceptions of solitude by increasing noise levels and visitor contacts or by degrading the natural character of the landscape in areas where unauthorized pioneered routes have proliferated. Under Alternative A, motorized vehicle use is limited to existing roads and trails in the Cedar Mountain and Honeycombs WSAs, and limited to designated roads and trails in the Trapper Creek, Medicine Lodge, Alkali Creek, and McCullough Peaks WSAs (in those areas outside the Spanish Point Karst ACEC, which is closed to motorized vehicle use). The Owl Creek, Sheep Mountain, Red Butte, and Bobcat Draw Badlands WSAs are closed to motorized vehicle use under Alternative A to manage for maintaining their wilderness characteristics.

The proposed expansion of the Bobcat Draw Badlands WSA would result in beneficial impacts by restricting uses incompatible with the preservation of wilderness characteristics on an additional 1,290 acres. No other land acquisitions or disposal actions are proposed for WSAs under this alternative.

All WSR eligible waterway segments are managed to protect their free-flowing nature, ORVs, and tentative classifications. Segments of Medicine Lodge Creek and Trapper Creek lie within similarly named WSAs. Under Alternative A, these special designations include additional resource protection measures that prohibit surface-disturbing activities such as range improvements, exclude ROWs, and close these segments to motorized vehicle use. These protective measures would result in beneficial impacts to WSAs by further protecting wilderness characteristics.

Alternative B

Alternative B is the most restrictive alternative for motorized and mechanized vehicle travel and would be the most beneficial to the preservation of wilderness characteristics such as opportunities for solitude and primitive recreation. Management under this alternative maintains the closures under Alternative A and expands them to include all areas in the WSAs and mechanized vehicle travel.

Lands and realty management under Alternative B would provide the BLM flexibility to acquire WSA inholdings and may, therefore, have the greatest beneficial impact on eliminating any incompatible uses (e.g., extensive surface disturbances with strong visual contrast) occurring on these non BLM-administered parcels. The identification of land-tenure adjustment zones may result in beneficial impacts to WSAs by increasing the potential for and expediting the disposal of inholdings or the acquisition of areas with high wilderness characteristics values that increase the manageability of WSAs.

Under Alternative B, designating approximately 571,288 acres of LWCs as Wild Lands and managing them to protect wilderness characteristics would decrease incompatible land uses adjacent to some WSAs, resulting in beneficial impacts to the wilderness characteristics in WSAs. Because many of the Wild Lands are adjacent to or surround the WSAs, adverse impacts to wilderness characteristics from adjacent land uses (e.g., intensive oil and gas development) would be limited along the boundaries of the WSAs.

Impacts to WSAs from WSRs would be similar to Alternative A, except that the Dry Medicine Lodge Creek WSR, a portion of which is in the Medicine Lodge WSA, includes additional management actions for resource protection under this alternative that would further protect the wilderness characteristics of the WSA.

Alternative C

Alternative C is the least restrictive for motorized vehicle use in WSAs and would be the least beneficial to the preservation of wilderness characteristics. Under Alternative C, motorized vehicle use is limited to designated roads and trails in all WSAs. Management of the Cedar Mountain and Honeycombs WSAs under Alternative C would provide greater protection of the areas' wilderness characteristics than management under Alternative A. The less restrictive designations in the remaining WSAs, especially Owl Creek, Sheep Mountain, Red Butte, and Bobcat Draw Badlands – closed to motorized vehicle use under Alternative A but limited to designated trails under Alternative C – would provide the least benefit to the preservation of wilderness characteristics of any alternative.

Under Alternative C, the BLM does not pursue the acquisition of inholdings, lands, or interests in lands within WSA boundaries, which would result in adverse impacts to WSAs by decreasing lands transactions that consolidate lands in WSAs and increase the ability to meet management objectives that help maintain or improve wilderness characteristics. Reducing the potential for land transactions in WSAs also would result in adverse impacts by reducing the flexibility to mitigate the effects of incompatible adjacent uses through land-tenure adjustments.

Under Alternative C, management of WSR eligible waterway segments would not benefit wilderness characteristics in the WSAs, because the BLM does not manage waterways to maintain their ORVs.

Alternative D

Alternative D is generally more restrictive of travel in WSAs than alternatives A or C, but less than Alternative B. Alternative D limits motorized vehicle use to designated roads and trails in the Cedar Mountain, Honeycombs, Trapper Creek, Medicine Lodge, and Alkali Creek WSAs (as under Alternative

C), carries forward the McCullough Peaks Travel Management Plan (as under Alternative A), and closes the Owl Creek, Sheep Mountain, Red Butte, and Bobcat Draw Badlands to motorized vehicle use (as under Alternative A). Beneficial impacts to wilderness characteristics from travel management in these areas would be similar to those identified under alternatives A and B.

As under Alternative B, the BLM would have flexibility under Alternative D to acquire WSA inholdings or interests in lands within WSA boundaries, which could result in beneficial impacts by eliminating uses incompatible with the preservation of wilderness characteristics occurring on these non BLM-administered parcels. Alternative D also includes land-tenure zones that would increase the potential for and expedite the disposal of inholdings or the acquisition of areas with high wilderness characteristics values that increase the manageability of WSAs. Designating some LWCs as Wild Lands (52,485 acres) would result in similar impacts to WSAs as those described under Alternative B, but to a lesser extent. Under Alternative D, the BLM does not manage WSR eligible waterway segments to maintain their ORVs or wilderness characteristics, so no beneficial impacts would be conveyed to WSAs where these areas overlap or adjoin other special designations.

4.8 Socioeconomic Resources

4.8.1 Social Conditions

This section addresses the potential for the alternatives to have impacts on social conditions in the Planning Area, including direct, indirect, short-term, and long-term impacts. Laws, regulations, policies, and guidance considered in the analysis of social conditions are identified in Appendix B.

Potential impacts to social conditions include changes in population, such as fluctuations caused by economic boom and bust cycles; changes in the demand for housing and community services along with community fiscal conditions, which can affect the ability of state, regional, and local governments to supply community services such as education; and changes in community character, culture, and social trends.

The BLM does not directly manage social conditions in the Planning Area. However, BLM management actions have the potential to indirectly affect social conditions. For example, a decision to prohibit future oil and gas exploration or leasing on BLM-administered mineral estate may adversely affect job opportunities in the Planning Area, which may lead to a reduction in populations in parts of the Planning Area as residents move away to find job opportunities elsewhere (or as fewer people move to the Planning Area for jobs).

4.8.1.1 Methods and Assumptions

The Impact Analysis for Planning model (IMPLAN) was used to estimate socioeconomic impacts resulting from BLM management actions under the alternatives. IMPLAN is a regional economic model that provides a mathematical accounting of the flow of money, goods, and services through a region's economy. The model provides estimates of how a specific economic activity translates into jobs and income for the region. It includes the "ripple effect" (or "multiplier effect") of changes in sectors that may not be directly affected by management actions, but are linked to industries that are directly affected. In IMPLAN, these ripple effects are termed indirect impacts (for changes in industries that sell inputs to the industries that are directly affected) and induced impacts (for changes in household spending as household income increases or decreases due to the changes in production).

For example, an increase in oil and gas production implies more money would be spent on the maintenance of existing oil and gas equipment and/or new oil and gas equipment; this, in turn, implies more money would be spent in sectors that provide inputs to oil and gas support services or equipment sectors. These production and consumption or "input-output" relationships allow IMPLAN to estimate the indirect and induced impacts based on changes in production that may result from an alternative. Appendix X provides technical assumptions and additional information about the IMPLAN model.

Impacts to social conditions associated with each of the alternatives were compared to existing conditions and trends in the Planning Area to establish a context for the impacts. Social impacts were classified broadly into three categories: impacts on population; impacts on housing and community services; and impacts on custom, culture, and social trends.

Assumptions used in this impact analysis include the following:

- Economic conditions, especially jobs, labor earnings, and economic output, will continue to drive population growth or decline in the Planning Area.
- Any population change that may reasonably be associated with the alternatives will likely be due to changes in employment opportunities.

- Federal, state, and local taxes will continue to be collected on minerals produced in the Planning Area.
- The pace and timing of economic development in the Planning Area will continue to depend on many factors beyond the management actions of the BLM. Because the pace of development in the Planning Area is driven largely by external forces such as worldwide economic trends and technological change, it is difficult to predict. Therefore, the economic impact analysis—which influences the social impact analysis because of the link between employment opportunities and population—assumes a relatively constant rate of development. Actual social and economic impacts may differ if the rate of development changes.

4.8.1.2 Summary of Impacts by Alternative

Social conditions are fundamentally influenced by economic conditions, which may influence market values such as the growth or development of employment and income, and nonmarket values such as air quality, wildlife, recreation values, and other resources that improve or detract from social conditions and quality of life. The economic sectors in the Planning Area that are most likely to be directly affected by BLM management actions are related to the service sector (e.g., accommodation and food services used by people visiting the area for recreation or temporary work) and resource development activities (e.g., oil and gas). This does not imply that grazing, ranching, and other agricultural activities are unaffected or unimportant. However, based on their economic contribution to the overall economy, changes in the agricultural sector would be expected to produce relatively minor direct impacts in the overall economy. Nevertheless, the agricultural sector in the Planning Area is influential in terms of community character and identity. Thus, land management decisions affecting the agricultural sector may result in important impacts to the social structure in the Planning Area even though the economic impacts are expected to be minimal.

Table 4-20 provides a summary of impacts on social conditions as discussed in this section for the alternatives. Although the table attempts to summarize impacts and characterize them as low, medium, or high, it does not classify these impacts as beneficial or adverse. Social impacts seen as beneficial to some people and groups may be seen as adverse to others. For instance, increased emphasis on resource conservation in Alternative B would result in a change from the current uses, which may be seen as a beneficial impact by wilderness advocates, but an adverse impact by oil and gas development and livestock grazing interests. In Table 4-20, high impacts are those that would result in substantial changes to an existing condition in a way that would affect a large number of people and/or endure for a long period of time; no high impacts were identified during this analysis. Low impacts are those that would affect a limited number of people and for a limited period of time. Medium impacts are intermediate and fall between high and low impacts.

Under all alternatives, the social condition is expected to change. However, the greatest impact on social conditions under Alternative B would be from reduced oil and gas development and livestock grazing and increased emphasis on resource conservation and recreational opportunities. Under Alternative C, the greatest impact on social conditions would result from decreased restrictions on oil and gas development compared to the other alternatives, which would bring more job opportunities, greater demand for community services, and greater tax revenues to local governments—allowing them to expand community services to meet the needs of a slightly higher population. Alternative D balances management emphasis between resource conservation and resource use, but is generally closer in line with resource use and development.

Table 4-20. Overall Impacts on Social Conditions by Alternative

Impact	Alternative A	Alternative B	Alternative C	Alternative D
Impact on Population	Low Impact	Medium Impact (potential reductions focused in oil/gas service areas, which generally correspond to population centers)	Low Impact	Low Impact
Impact on Housing and Community Services	Low Impact	Medium Impact (due to potential population reductions)	Low Impact	Low Impact
Consistency with Adopted County Land Use Plans	No Impact	Potential conflict with Hot Springs County Land Use Plan	No Impact	No Impact
Impacts on Quality of Life and Local Culture	Low Impact	Medium Impact (change from recent trends would constitute greater emphasis on resource conservation at the expense of traditional industries such as livestock grazing)	Medium Impact (change from recent trends would constitute greater emphasis on resource development)	Low Impact

Source: Based on the analysis of impacts to social conditions, as described in the text.

4.8.1.3 Detailed Analysis of Alternatives

The analysis of impacts on social conditions focuses on the effects of BLM-authorized actions. It is important to note that many other events outside of the BLM's control may alter economic and social trends. For instance, oil and gas prices may change as a result of an expansion or contraction of world or national economic activity, and this, in turn, may affect the pace of development or the quantity of development. Similarly, state and local laws regulating the subdivision of land may alter land ownership and development patterns, which may in turn affect open space and physical landscapes. Minimal or no changes to social conditions resulting from BLM actions does not imply that no change could occur, as other forces may drive changes in economic and social trends.

Impacts Common to All Alternatives

Humans and associated social and economic conditions are an integral part of ecosystem and community function in the Planning Area. Lifestyles, attitudes, beliefs, values, social structure, culture, and population characteristics affect and are affected by management actions made by the BLM in the Planning Area. In addition, both the Planning Area lands and BLM management of these lands have emotional meanings for many people. Varying viewpoints on economic development and conservation of natural resources are expected to cause controversy related to management of BLM-administered land and federal mineral estate.

Any population change that could reasonably be associated with the alternatives may be due to changes in employment opportunities. Employment opportunities related to activities on BLM-administered land and mineral estate include jobs in exploration, development, and production of minerals, including oil and gas, coal, locatable and salable minerals; jobs in livestock production; and jobs in various recreation activities. The economic analysis provides quantitative estimates of employment in the Planning Area from oil and gas exploration and development, grazing, and recreation activities on BLM-administered lands and mineral estate. These quantitative estimates are used to analyze impacts from management on population.

The social and economic values associated with BLM-administered lands include market values and nonmarket values. Market values are those related to goods and services that are typically bought and sold in markets. For example, commodities such as oil and gas, bentonite, crops, livestock products, and services such as outfitter trips and fishing guides are traded in markets. The production and sale of these goods and services result in jobs and income and the value of these goods to society can be readily expressed in monetary terms. Nonmarket values relate to things that people value, but are not generally bought or sold in markets. For example, many people may value the ability to see a mountain range from a certain vista point without human-caused impacts to visibility in the air. Some people value open vistas that lack structures, fences, wind turbines, or other signs of human development. Some people may place a high value on their ability to hunt or fish on public lands, and the satisfaction they derive from this ability may exceed the equivalent monetary cost of purchasing the same amount of food from the grocery store. Other people may value the knowledge that their offspring will enjoy clean air, open vistas, and the ability to fish and hunt. The common feature of these values is that they are generally not bought and sold like tangible goods and services, and for that reason are difficult to assign a monetary value. Other examples of nonmarket values include the satisfaction people derive from resources such as clean water, biological resources (e.g., wildlife), cultural resources, or even the satisfaction they derive from the knowledge that the BLM uses a particular fire management or invasive species control regime.

Some of the value associated with open space and other features is captured in markets. For example, the price of a house that overlooks a pristine mountain range may be higher than the price of a house that is identical in almost every respect but overlooks a cement factory. However, the ability to see an open landscape while driving along a highway is not likely to be captured in the market.

A related concept is that some changes in management may affect both market and nonmarket values. For instance, industrial development that substantially alters visual characteristics of the landscape may, over time, result in a lower number of tourists visiting the area and spending money in local hotels, restaurants, and shops. This decline in tourism would result in adverse impacts on employment and income. Such industrial development could also reduce the satisfaction of local residents who value open space resulting in adverse impacts on nonmarket values. On the other hand, the new industrial development would also generate jobs and income, and the net effect—if all values were to be expressed in the same metric (dollars)—could be beneficial or adverse.

Although economists have developed approaches to assign a monetary value to things that are not traded in markets, the approaches for doing so are often complex, controversial (due to the subjective nature of assigning a dollar value to something that is neither bought nor sold), and require considerable resources and time to analyze and interpret properly. For example, stated preference methods (e.g., surveys) are a common approach for placing a monetary value on clean air and open views. A survey may present people with images of a mountain vista with different degrees of haze superimposed and ask people to express how much they are willing to pay for the ability to see the vista with lower levels of haze for a certain number of days per year. However, research has shown that the survey design, sample size, and outreach methods can have a dramatic influence on the results. Due to the complexity and cost of implementing nonmarket valuation methods, quantifying these values was beyond the scope of this RMP revision. However, the BLM recognizes that changes in nonmarket values are likely correlated with level of resource protection and development under each alternative. The development of oil and gas resources and other minerals, as well as development of ROWs, renewable energy facilities, and other structures, may result in adverse impacts to nonmarket values under all alternatives. Furthermore, alternatives emphasizing resource development over conservation may result in greater impacts to nonmarket values.

Because of the close relationship between nonmarket economic values and how individuals in the Planning Area perceive their own quality of life, impacts on nonmarket values are discussed qualitatively in the section on Quality of Life and Local Culture.

With mounting economic pressures on the livestock sector, some ranch owners have raised money for retirement or other purposes by subdividing portions of their land into "ranchettes" and selling them to individuals. The sale of these ranchettes provides financial liquidity to ranchers who frequently have most of their assets in land but generally results in increased construction of fences, houses, and sometimes other structures (e.g., barns), resulting in changes to the visual landscape. Under all alternatives, this trend is likely to continue because it is fundamentally related to (1) the nature of the ranching business (principally, the fact that most ranchers' assets are in land and the fact that profit margins are generally low and can turn negative in drought or other adverse conditions) and (2) state laws that govern property subdivision, under which county zoning laws cannot regulate subdivisions of 35 acres and larger. However, alternatives that adversely affect the profitability of ranching could serve to increase this trend. Because the subdivision of ranch land affects local culture and quality of life, impacts on this trend are discussed in the section on Quality of Life and Local Culture.

The economic and social analysis incorporates variations in pace of development over time. However, under all alternatives, the pace of development may differ from the rate assumed in the analysis. The BLM has limited control over the pace of development of leases because the agency only authorizes economic activities such as oil and gas drilling and does not conduct these activities. An abrupt shift in the pace of development may result in short-term impacts (beneficial or adverse) on demand for housing and community services and on the supply of tax revenues from residences or businesses to support community services, due to short-term changes in job opportunities and the resulting change in immigration or emigration trends. Any such impacts may be more severe for smaller communities, which are less likely to be able to absorb a sudden increase in population or to continue to support existing infrastructure if the population were to suddenly decrease.

The BLM did consider an alternative that would regulate the rate of oil and gas development in the Planning Area, but determined that the holders of federal oil and gas leases have the right to develop those leases. In addition, the BLM determined that setting reduced or limited rates of development is more appropriately analyzed in site-specific NEPA documents. The BLM therefore eliminated this alternative from detailed analysis. For more information, see the *Alternatives Considered but Not Carried Forward for Detailed Analysis* section in Chapter 2.

Under all alternatives, the BLM continues to consider socioeconomic impacts of site-specific actions and incorporates socioeconomic issues into analyses of environmental, social, and economic impacts, such as the analyses required by NEPA for site-specific actions.

Alternative A

Impacts on Population

As noted under Impacts Common to All Alternatives, changes in employment opportunities may result in changes to population and demographics. Under Alternative A, activities on BLM-administered land and mineral estate related to oil and gas, livestock grazing, and recreation would support an average of 1,465 full-time and part-time jobs per year (Table 4-21) which represents approximately 3.9-percent of total employment in the Planning Area using 2008 employment statistics. It is important to note that this does not constitute an increase of 1,466 jobs per year over current employment, it more closely represents an estimate of the contribution of certain activities on BLM-administered lands and mineral estate to overall employment in the Planning Area.

Table 4-21. Comparison of Projected Earnings and Employment to 2008 Levels

Measure	Alternative A	Alternative B	Alternative C	Alternative D
Forecasted annual earnings due to activities on BLM-administered surface[1] ($ millions)	$75.0	$36.9	$83.4	$70.8
Total labor earnings in 2008 ($ millions)	$2,098	$2,098	$2,098	$2,098
Forecasted annual earnings as a percentage of 2008 earnings	3.6%	1.8%	4.0%	3.4%
Forecasted annual employment due to activities on BLM-administered surface[1]	1,465	796	1,606	1,393
Total employment in 2008	37,221	37,221	37,221	37,221
Forecasted annual employment as a percentage of 2008 employment	3.9%	2.1%	4.3%	3.7%

Source: Forecasted annual earnings and employment are calculated based on the IMPLAN model, as described in the text. Earnings and employment for 2008 are from the Bureau of Economic Analysis (BEA 2010a). Earnings are in millions of year 2008 dollars.
[1]Estimate of annual earnings and employment includes direct, indirect, and induced economic activity (the "multiplier effect").
IMPLAN Impact Analysis for Planning model
BLM Bureau of Land Management

Approximately 77 percent of the job opportunities from activities analyzed using the IMPLAN model would be related to oil and gas development and production (1,121 jobs). Livestock grazing would contribute approximately 13 percent of the job opportunities (186 jobs) and recreation would contribute approximately 11 percent (158 jobs). These jobs would be dispersed geographically across the Planning Area because all three sectors operate across the Planning Area. Section 3.8 *Socioeconomic Resources* in Chapter 3 describes the geographic distribution of economic activities that occur on BLM-administered lands.

Job opportunities (and resulting increases or shifts in population) may concentrate in population centers such as Cody, Powell, and Worland. Management under Alternative A may not result in noticeable impacts to the current distribution of job opportunities in the Planning Area for a variety of reasons. Alternative A maintains current management where the contribution of economic activity on BLM-administered lands accounts for a relatively small proportion of jobs in the Planning Area (3.9 percent, according to the IMPLAN analysis of oil and gas, livestock grazing, and recreation for Alternative A). Also, the IMPLAN analysis considers jobs in all sectors, including those industries directly affected by BLM actions (e.g., oil and gas production) as well as those affected indirectly (e.g., retail jobs created by expenditures of workers in various industries). As a result, Alternative A would not alter the overall trend of BLM-authorized activities and associated population changes in the Planning Area.

Impacts on Housing and Community Services

Changes in population have the potential to change the demand for housing and community services such as roads, schools, and police and fire protection. As described in Chapter 3, county-wide vacancy rates in 2000 (the latest year for which data are available at this resolution) were 15.5 percent in Big Horn County, 17.2 percent in Hot Springs County, 13.1 percent in Park County, and 10.3 percent in Washakie County. These percentages represent approximately 800, 400, 1,600, and 400 vacant units in Big Horn, Hot Springs, Park, and Washakie counties, respectively. Vacancy rates for rental properties in the Planning Area have declined since 2001-2002. However, because Alternative A would not result in a change in direction of current BLM management, a change in either the total demand for housing and community services or its geographic distribution is not expected.

If development occurs slower or faster than the relatively steady pace assumed in the analysis, there may be short-term impacts on demand for housing and community services and on the supply of tax revenues from residences or businesses to support community services. It may be more difficult for smaller communities to absorb sudden changes of this nature. If national and international energy prices, operator business strategies, or other factors lead to a rapid pace of development there may be sudden short-term increases in demand for community services as a result of new jobs and increased population. However, local and state tax revenues collected from energy production could help to mitigate short-term increases in demand for services, since tax revenues help to pay for community services.

Consistency with Adopted County Land Use Plans

BLM land use plans must be consistent with state and local land use plans to the maximum extent consistent with federal law, including FLPMA. The BLM takes practical steps to resolve any identified conflicts between federal and local plans. Section 3.8.1 *Social Conditions* in Chapter 3 summarizes adopted land use plans for each of the counties. Alternative A would maintain existing policies for BLM land management and would not result in any inconsistencies or conflicts with existing county land use plans.

Impacts on Quality of Life and Local Culture

Historically, the communities in the Planning Area developed around a combination of resource-based industries, ranching, trade and commerce, and providing supplies and services to tourists. Quality of life for the people who live in the Planning Area depends on continued economic opportunities as well as features of the natural landscape. Alternative A continues current BLM management. Historically, these policies have contributed, along with other government policies and the actions of private firms and residents, to economic viability and resilience in the Planning Area. Despite these policies and actions, several communities in the Planning Area have experienced and continue to experience declines in population and increases in median age. The BLM believes that a balanced management approach continues to be best for improving the capability of communities to respond to technological, demographic, and economic change. Alternative A would allow other forces (beyond BLM-authorized actions) to drive changes to the economic, physical, and social conditions in the Planning Area.

Although there are groups with particular interests in the management of certain resources and resource uses (e.g., wilderness advocates, oil and gas interests, and ranchers), overall the residents of the Planning Area tend to support both conservation of natural resources and the economic viability of resource-based industries. For this reason, residents generally support multiple-use of BLM lands, including the development of mineral and energy resources, livestock grazing authorizations, continued access to BLM-administered lands for recreation, and conservation of wildlife and native vegetation.

Under this alternative, continued development of oil and gas wells, ROWs, and other human-made structures on the landscape would continue to result in decreases in nonmarket values associated with open space and the environment. Because Alternative A essentially represents continuation of current management, these decreases may be similar to historic trends. Under this alternative, subdivision of ranch land and related development and sale of “ranchette” parcels would continue, generally consistent with historic trends. The development of these “ranchette” parcels increases institutional challenges, such as those related to provision of community services and management of invasive plant species. In addition, the development of “ranchettes” may adversely affect the value of land as wildlife habitat by increasing the number of fences and other barriers to wildlife movement.

Alternative B

Impacts on Population

Under Alternative B, activities on BLM-administered land and mineral estate related to oil and gas, livestock grazing, and recreation would support an average of 796 full-time and part-time jobs per year, which represents approximately 2.1 percent of total employment in the Planning Area as of 2008 (Table 4-21). Compared to Alternative A, this represents a decrease of 669 jobs (approximate 46 percent decrease), or approximately 1.8 percent of employment using 2008 employment statistics. Most of these job losses are related to restrictions on development of oil and gas resources (617 jobs), with the remainder related to reduced livestock grazing (52 jobs). Due to restrictions on oil and gas development under Alternative B, more oil and gas wells may be drilled on nearby state or fee surface land, partially compensating for the projected employment decrease in that sector.

A decrease in employment opportunities may result in a decrease in population in the Planning Area as people may leave the area to seek employment elsewhere. The expected magnitude of any such decrease would be similar to the magnitude of employment loss but would be lower since some people (e.g., retired people) survive on unearned income and do not depend directly on employment for economic well-being. In other words, if 1.8 percent of employed people and their families leave the Planning Area, the population would decrease by less than 1.8 percent because some residents of the Planning Area are retired or otherwise non-working families.

Approximately 63 percent of the job opportunities from activities analyzed using the IMPLAN model would be related to oil and gas development and production under Alternative B (505 jobs). Livestock grazing would contribute approximately 17 percent of the job opportunities (134 jobs), and recreation would contribute approximately 20 percent (158 jobs). (Note that due to rounding, these sector breakouts do not necessarily add up to the total reported above.) These jobs would be dispersed geographically across the Planning Area as described under Alternative A. The average annual number of jobs supported by recreation activities would be the same across all alternatives; however, average annual jobs and income supported by oil and gas would decrease by approximately 55 percent compared to Alternative A, and jobs and income supported by livestock grazing would decrease by approximately 28 percent compared to Alternative A.

Job opportunities and job losses (and resulting shifts in population) in Alternative B may concentrate in population centers. Because the majority of job losses in Alternative B would be related to decreased oil and gas development, the greatest population changes would occur in areas that service oil and gas fields (e.g., Cody). Oil and gas fields occur throughout the basin, and overall the distribution of any job losses would also likely occur throughout the basin. Jobs and income lost in the livestock grazing industry would also affect workers throughout the Planning Area. The adverse effects on grazing operations from the loss of access to federal allotments could also result in substantial adverse financial effects for some individual ranching operations, depending on how specific operations use the federal allotments and how important a role BLM-administered lands play in financing and production. The IMPLAN model does not account for “cascade” type effects such as the potential for individual operations to fail. Failing operations could have subsequent indirect impacts on social and economic conditions in communities. For example, a loss of individual grazing operations could result in reduced income for retail businesses that supplied the lost operations (e.g., feed and supply stores). Financial threats to grazing operations could increase land sales to residential developers and the spread of “ranchettes.” Note, however, that the failure of individual operators does not necessarily mean that the operation will cease to exist or will immediately be developed into residential or ranchette parcels. Historically, many ranching and grazing operations have changed hands while being maintained in

ranching and grazing. In some of these cases, the new owners have been less dependent on livestock grazing for financial security, so the emphasis of the operation may change but the operation does not cease to exist in its entirety. In other cases, subdivisions have sprung up, creating new challenges. This topic is discussed with further detail in the section on quality of life and local culture, below.

Impacts on Housing and Community Services

Alternative B may result in decreased population compared to other alternatives, which may result in decreased demand for housing and community services. Alternative B would also result in a reduced tax base for providing community services, as described in Section 4.8.2 *Economic Conditions*. The exact geographic distribution of these changes is not possible to predict because tax losses in specific jurisdictions would be driven by undetermined well locations; however, the restrictions on oil and gas development in Alternative B affect broad areas of land throughout the Planning Area, so the reductions in tax revenues would likely affect all communities that currently produce oil and/or gas.

Consistency with Adopted County Land Use Plans

As described under Alternative A, the BLM takes practical steps to resolve any identified conflicts between federal and local plans. Under Alternative B, increased restrictions on oil and gas development could be perceived as a conflict with the Hot Springs County Land Use Plan, which expresses concern about growing federal and state regulation on public lands that may slow or hinder economic development. Alternative B would not conflict with the adopted land use plans of Big Horn, Park, or Washakie counties.

Impacts on Quality of Life and Local Culture

As described under Alternative A, quality of life for the people who live in the Planning Area depends on continued economic opportunities as well as features of the natural landscape. Alternative B would reduce economic opportunities, but would also result in decreased air pollution and other adverse environmental impacts associated with development (e.g., oil and gas) compared to the other alternatives.

As noted under Alternative A, residents generally support multiple-use of BLM lands, including the development of mineral and energy resources, livestock grazing authorizations, continued access of BLM lands for recreation, and conservation of wildlife and native vegetation. Alternative B would continue the BLM's current practice of allowing multiple-uses, but would prioritize resource conservation over resource uses such as oil and gas development. This may be inconsistent with the culture advocated by some interest groups (e.g., oil and gas interests, livestock ranchers) and may promote the culture advocated by others (e.g., wilderness advocates).

Under this alternative, continued development of oil and gas wells, ROWs, and other human-made structures on the landscape would continue to result in adverse impacts to nonmarket values associated with open space and the environment. However, because this alternative emphasizes resource conservation, the magnitude of these decreases would be less than historic trends and less than under the other alternatives.

From a distributional perspective, the withdrawal of livestock grazing areas in Alternative B would result in a substantial impact on a substantial number of allotments, and potentially on a substantial number of livestock operators. BLM currently allows grazing on 673 allotments in the Planning Area. Livestock grazing withdrawals on these allotments would result in the loss of at least half the AUMs on 44 percent of the allotments, the loss of at least three-quarters of the AUMs on 25 percent of allotments, and the loss of nine-tenths or more of the AUMs on 15 percent of the allotments in the Planning Area.

Furthermore, the losses in Alternative B would affect allotments in all size categories, and allotments spread over the entire Planning Area. Some ranchers may be able to continue operating, albeit at a reduced level, by using more state and private land. However, many ranchers may be forced to cut back their operations, sell their ranch to another operator (consolidate operations), or find alternative ways to make a living. This would certainly result in substantial impacts on individual ranchers, and depending on potential "cascade" effects, could also result in accelerated subdivision of ranch land, sales of ranch land to residential developers, development of "ranchette" parcels, and the resulting conversion of ranch land to residential areas. However, as noted above, the failure of individual operators does not necessarily mean that the operation will cease to exist or will immediately be developed into residential or ranchette parcels.

Alternative C

Impacts on Population

Under Alternative C, activities on BLM-administered land and mineral estate related to oil and gas, livestock grazing, and recreation would support an average of 1,606 full-time and part-time jobs per year (Table 4-21), which represents approximately 4.3 percent of total employment in the Planning Area using 2008 employment statistics. Compared to Alternative A, which essentially represents the continuation of current trends, Alternative C would result in an increase of 141 jobs (approximate 10 percent increase), or approximately 0.4 percent of employment using 2008 employment statistics. These job increases would be associated with increased development of oil and gas resources.

An increase in employment opportunities may result in an increase in population in the Planning Area as people are drawn to the new jobs. The expected magnitude of any such increase would be similar to the magnitude of employment gained, as new employees move to the area with their families.

As shown in Section 4.8.2 *Economic Conditions*, approximately 79 percent of the job opportunities from activities analyzed using the IMPLAN model would be related to oil and gas development and production (1,263 jobs). Livestock grazing would contribute approximately 12 percent of the job opportunities (185 jobs), and recreation would contribute approximately 10 percent (158). These jobs would be dispersed geographically across the Planning Area as described under Alternative A. The average annual number of jobs supported by recreation activities would be the same as Alternative A; however, average annual jobs supported by oil and gas would increase by approximately 28 percent compared to Alternative A, and jobs supported by livestock grazing would decrease by approximately 0.6 percent (one job) compared to Alternative A.

Overall, Alternative C would result in more job opportunities and may result in increased population compared to the other alternatives. Although Alternative C would result in increased job opportunities and population compared to the other alternatives, it would still not considerably alter the relative distribution of job opportunities or substantially affect population increase or movement in the region due to the factors described under Alternative A.

Impacts on Housing and Community Services

Alternative C may result in increased population leading to higher demand for housing and community services compared to alternatives A, B, and D. Alternative C would result in a greater tax base for providing these services, as described in Section 4.8.2 *Economic Conditions*. The geographic distribution of these changes is not possible to predict because higher tax revenues in specific jurisdictions would be driven by undetermined well locations. Oil and gas occurs throughout the basin, and the RFD does not predict specific well locations.

An increase in population sometimes results in population growth that overwhelms the ability of town or county governments to provide services. This is not expected to occur as a result of the BLM's actions under Alternative C, for several reasons. First, the estimated increase would be spread over a relatively large area (four counties) and would likely "ramp up" over a relatively long time period. Second, based on county land use plans and information from city planning departments, rising population (at least on this scale) would not lead to the inability to provide infrastructure or community services. Several planning documents refer to the issue or problem of declining population, especially working-age population, and recommend increasing the use of public lands for development of oil and gas and other industries that can provide jobs. This implies that the supply of infrastructure and services exceeds the demand. This conclusion is also consistent with the descriptions of the infrastructure in counties' planning documents (e.g., the Big Horn County Land Use Plan, which describes the service capacity for each of the towns in Big Horn County for water, wastewater, and other services and, in virtually all cases, concludes there is plenty of available capacity). The primary concerns regarding the availability of community services relate to the way in which new land is developed (spatial density or boom/bust cycles), rather than the total quantity of new development. Alternative C would not affect the spatial density of development, nor would it make boom/bust cycles more likely or substantially more severe. As a result, Alternative C would not likely have substantial effects on the ability of local governments to provide services.

Consistency with Adopted County Land Use Plans

Similar to the other alternatives, the BLM takes practical steps to resolve any identified conflicts between federal and local plans. The increased pace of oil and gas development under Alternative C may be perceived as creating a conflict with the Big Horn County Land Use Plan, as this plan identifies a need to diversify the region's economy, pointing to the idea that it relies relatively heavily on mining and public sector activities. However, the county has other policy instruments to encourage economic diversification and the BLM's actions under Alternative C would not likely limit the county's ability to use these other instruments. As a result, there would not likely be a conflict with the Big Horn County Land Use Plan. Alternative C would not conflict with the adopted land use plans of Hot Springs, Park, or Washakie counties.

Impacts on Quality of Life and Local Culture

Alternative C would increase economic opportunities in the Planning Area more than alternatives A, B, and D, which may result in beneficial impacts on quality of life. However, Alternative C may also result in adverse impacts to air quality, wildlife, and other resources that improve quality of life related to natural characteristics.

Alternative C would prioritize the use of resources such as oil and gas development over the conservation of resource such as air quality and wildlife. This management approach would be consistent with the culture advocated by some interest groups (e.g., oil and gas interests) and would be inconsistent with the culture advocated by others (e.g., wilderness advocates).

Under this alternative, continued development of oil and gas wells, ROWs, and other human-made structures on the landscape would continue to result in decreases in nonmarket values associated with open space and the environment. However, because this alternative emphasizes resource use and development, the magnitude of these decreases would be greater than historic trends and greater than under alternatives A, B, and D. Under this alternative, subdivision of ranch land and related development and sale of "ranchette" parcels would continue and would result in impacts similar to Alternative A. This continuation would generally be in line with historic trends, because Alternative C would have relatively little impact on the economics of ranching.

Alternative D

Impacts on Population

Under Alternative D, activities on BLM-administered land and mineral estate related to oil and gas, livestock grazing, and recreation would support an average of 1,393 full-time and part-time jobs per year (Table 4-21), which represents approximately 3.7 percent of total employment in the Planning Area using 2008 employment statistics. Compared to Alternative A, which essentially represents the continuation of current trends, Alternative D would result in a decrease of 72 jobs (approximate 5 percent decrease), or approximately 0.2 percent of year 2008 employment. Most of these job decreases would be associated with decreased development of oil and gas resources.

As shown in Section 4.8.2 *Economic Conditions*, approximately 75 percent of the job opportunities from activities analyzed using the IMPLAN model would be related to oil and gas development and production (1,050 jobs). Livestock grazing would contribute approximately 13 percent of the job opportunities (186 jobs), and recreation would contribute approximately 11 percent (158). (Note that due to rounding, these sector-level figures do not necessarily match the total reported above.) These jobs would be dispersed geographically across the Planning Area, as described under Alternative A. The average annual number of jobs supported by recreation activities and livestock grazing would be identical to that under Alternative A; however, average annual jobs supported by oil and gas would decrease by approximately 6 percent compared to Alternative A.

Overall, Alternative D would result in a slight decrease in job opportunities and, therefore, may result in a slight decrease in population compared to Alternative A. Alternative D would result in more job opportunities than Alternative B, but less than Alternative C. Because the change in population and employment would be very small, spread over time, and spread throughout the Planning Area, Alternative D would not considerably alter the relative distribution of job opportunities or substantially affect population increase or movement.

Impacts on Housing and Community Services

Alternative D may result in a small decrease in population compared to Alternative A, which may result in a small decrease in demand for housing and community services. Alternative D would also result in a slightly reduced tax base from oil and gas production (about 6 percent) for providing community services, as described in Section 4.8.2 *Economic Conditions*. Geographically, the change in job opportunities—and related impacts on housing and community services—would be spread across the Planning Area and would be spread over time.

Consistency with Adopted County Land Use Plans

Similar to the other alternatives, the BLM takes practical steps to resolve any identified conflicts between federal and local plans. Alternative D continues the BLM's historical policy of balanced resource conservation and development, which encourages diversified economic activities by providing opportunities for developers to extract resources (e.g., oil and gas extraction) as well as develop industries that are sustainable in the very long term (e.g., renewable energy). Alternative D does not conflict with the adopted land use plans of Big Horn, Hot Springs, Park, or Washakie counties.

Impacts on Quality of Life and Local Culture

Alternative D would provide economic opportunities in the Planning Area very similar to, although slightly less than, Alternative A. Alternative D would also result in some beneficial impacts to air quality, wildlife, and other resources that improve quality of life related to natural characteristics. The balanced

management approach under Alternative D could increase the quality of life in the long term and increase the economic viability and sustainability of communities.

Alternative D would balance the use of resources such as oil and gas reserves with the conservation of resources such as air quality, open space, and wildlife habitat. Alternative D balances the culture advocated by some interest groups (e.g., oil and gas interests) with those of others (e.g., wilderness advocates). Alternative D provides for resource development and associated job opportunities while managing for nonmarket values associated with open space and natural characteristics.

Under this alternative, subdivision of ranch land and related development and sale of "ranchette" parcels would continue and would result in impacts similar to Alternative A. This continuation would generally be in line with historic trends, because Alternative D would have relatively little impact on the economics of ranching.

4.8.2 Economic Conditions

This section addresses the potential for the alternatives to result in impacts on economic conditions in the Planning Area, including direct, indirect, short-term, and long-term impacts. Laws, executive orders, regulations, policies, and guidance considered in the analysis of economic conditions are identified in Appendix B.

Potential impacts include changes in regional economic output, employment, and earnings, and in tax revenues for the local, state, and federal governments. The economic modeling analysis assumes direct and indirect impacts occur simultaneously even though in reality these impacts may take time to work their way through the economic sectors in the analysis area. For example, an action to permit gas exploration and production may result in the direct infusion of money into several economic sectors and indirect infusions into related sectors, such as retail, accommodation, and food services and education and other social services. In economic modeling, these impacts would be assumed to occur instantaneously. Continued direct infusion of money into the Planning Area's economy created by the decision to lease oil and gas would be analyzed over the life of the project, which in this case is likely to represent a multi-year period of production. As a result, the analysis of impacts to economic conditions is designed to account for the economic activity produced by planning decisions over time. The impacts are estimated on an annual basis through 2028 based on the estimated annual direct impact of the alternatives.

4.8.2.1 Methods and Assumptions

The analysis in this section is based on the IMPLAN model as described at the beginning of the Socioeconomic Resources section. IMPLAN focuses on employment and labor earnings and does not explicitly address non-labor income such as transfer payments (e.g., Social Security), investment earnings, or rent. As a result, the focus of this analysis is limited to the segment of the economy that is based on work-related income. The effects of non-labor income should be considered when interpreting the results of the IMPLAN model as substantial portions of income in some locations in the Planning Area come from non-labor income (e.g., Park County where nearly 40 percent of personal income is from non-labor income).

Assumptions used in this analysis include the following:

- Employment, earnings, and output are indicators of economic and population change.
- BLM-influenced activities alter economic conditions. Economic benefits to the Planning Area accrue from BLM-influenced activities, such as oil and natural gas development, livestock

grazing, and recreation. Economic benefits to the Planning Area also accrue from wildlife grazing, to the extent that wildlife grazing contributes to the availability of and demand for recreational activities. Conversely, the possibility of economic losses to the Planning Area due to BLM-influenced activities is recognized and evaluated.

- Indirect and induced benefits due to minerals, livestock grazing, and recreation can reasonably be estimated by the IMPLAN model. (The IMPLAN production coefficients were modified to reflect the interaction of producing sectors in the Planning Area.)
- Recreation-related expenditures by residents occur in the region, but do not represent new money coming into the Planning Area; therefore, the analysis of economic impacts from recreation considers only recreation expenditures of nonresidents in the four-county Planning Area. In other words, there is a multiplier effect associated with nonresident recreation-related spending because it results in an input of new money into the Planning Area. By comparison, it is assumed that recreation-related expenditures of people who live within the Planning Area would generally be spent within the area (although not necessarily on the same activities), given the set of possible management actions represented by the range of alternatives analyzed.
- The analysis of direct and indirect impacts associated with oil and gas activity considers only activities on BLM-administered surface and federal mineral estate. The cumulative analysis considers activities on state and fee land and mineral estate.
- For livestock grazing, the analysis reflects a "worst-case" assumption that all acres impacted by surface-disturbing actions (from all the sources listed in Appendix T) are lands currently permitted for grazing; thus, the number of acres available for grazing in 2027 is the number of acres available under each alternative, minus acres that are affected in the long term by surface-disturbing actions (and withdrawals). In addition, the analysis of grazing reflects the assumption that surface-disturbing actions occur at a constant rate over time.
- For livestock grazing, the analysis of baseline AUMs available and reductions in AUMs is adjusted for the ratio of authorized use to active use, which is calculated based on the long-term average of authorized and active AUMs for the Planning Area from 1988 to 2009. This long-term average is 64.21 percent. Appendix X contains additional details regarding this adjustment.

The pace and timing of economic development in the Planning Area depends on many factors beyond BLM management. These include national and international energy demand, supply, and prices; operator business strategies; production conditions within the Planning Area; and demand and supply for agricultural products. Because the future pace of development in the Planning Area is unknown, this analysis assumes a relatively constant rate of development. Therefore, actual impacts may differ if the rate of development changes substantially (e.g., there may be boom and bust type short-term impacts that would differ from long-term impacts).

The IMPLAN production coefficients were modified to reflect the interaction of producing sectors in the Planning Area. As a result, the calibrated model does a better job of generating multipliers and the subsequent impacts that reflect the interaction between and among the sectors in the Planning Area, compared to a model using unadjusted national coefficients. Specifically, worker productivity in oil and gas production is higher in Wyoming and more of the hay used for livestock feed is produced within the region, compared with national averages. Key variables used in the IMPLAN model were filled in using data specific to Wyoming, including employment estimates, labor earnings, and total industry output.

Appendix X describes the economic analysis method in more detail, along with detailed assumptions and factors for the analysis.

4.8.2.2 Summary of Impacts by Alternative

Based on the data from the IMPLAN model as well as qualitative analysis from other sectors, output, employment, and tax revenues resulting from activities on BLM-administered land and mineral estate would be highest under Alternative C and lowest under Alternative B. Alternative A would result in the second-highest level of economic activity, and Alternative D the third-highest. The amount of economic activity projected for alternatives A, C, and D is relatively similar with Alternative B resulting in substantially less economic activity. The most important driver of economic activity resulting from BLM management is oil and gas activity and the second most important driver is livestock grazing. Oil and gas activity would be highest under Alternative C, followed by alternatives A and D, and lowest under Alternative B. Economic activity from livestock grazing would be nearly identical between alternatives A, C, and D and substantially lower under Alternative B (employment from livestock grazing under Alternative B would be about 28 percent lower than under Alternative A). Earnings, output, and employment from recreation would be similar across all the alternatives.

Economic activity related to other sectors not modeled using IMPLAN, including renewable energy, locatable minerals, and salable minerals, would be similar across all the alternatives, at least in the first 5 to 10 years of the planning period. In the latter half of the planning period, economic activity from renewable energy may be somewhat higher under alternatives A, C, or D compared to Alternative B; however, the amount of activity is uncertain.

Table 4-21 compares projected earnings and employment related to activities on BLM-administered areas to the levels in 2008 for the four-county region. Alternative A would result in about $75 million in earnings and 1,465 jobs annually from BLM-administered land and resources. Alternative B would generate about $37 million in earnings and 796 jobs, while Alternative C would generate approximately $83 million in earnings and 1,606 jobs. Alternative D would generate about $71 million in earnings and 1,393 jobs. Therefore, Alternative C would result in the highest earnings and employment, followed by alternatives A, D, and B.

It is useful to compare the differences in earnings and employment across alternatives, not only in absolute terms, but also to the size of the regional economy. The earnings associated with Alternative A, compared to 2008 earnings for the Planning Area counties, represent slightly more than one-thirtieth (3.6 percent) of the total earnings in the Planning Area counties (Table 4-21). Earnings associated with BLM-administered lands under alternatives B, C, and D constitute 1.8, 4.0, and 3.4 percent of year 2008 earnings, respectively. The average employment associated with activities on BLM-administered land under alternatives A, B, C, and D represents about 3.9, 2.1, 4.3, and 3.7 percent of employment for counties in the Planning Area in year 2008, respectively (Table 4-21). This provides a useful perspective on the relative importance of BLM-administered lands in the overall regional economy and also shows that the difference between alternatives—relative to the regional economy—is small. For example, the difference in employment projected between alternatives A and B would be just 1.8 percent of employment in year 2008 (3.9 minus 2.1), which would be noticeable (it would be as if the unemployment rate increased by 1.8 percent) but would not lead to wholesale changes in regional economic activity. The difference in annual employment between alternatives A and D would be noticeable in regional statistics, but would still be just 0.2 percent, which is not likely noticeable for most residents or workers. Other national, state, and regional policies and trends, such as the value of the dollar, federal fiscal and monetary policy, and global oil prices, would have a substantially larger impact on economic activity in the Planning Area.

The data in Table 4-21, as well as the other tables in this section showing the results of the economic model analysis, reflect direct as well as indirect impacts on economic conditions. For example, the

earnings and employment information in this section include oil and gas, livestock grazing, and recreation sectors as well as all other sectors that are connected such as retail, food service, hotels and other accommodation services, and social services such as education and health care.

4.8.2.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

The focus of the following analysis is on the resource activities most likely to be affected by land management decisions, including oil and gas, livestock grazing, and recreation. Management of resource programs or constraints (as described in the alternatives) that affect oil and gas, livestock grazing, and recreation (e.g., surface-disturbing activities that affect the amount of land available for grazing) are included in the analysis. Also included are restrictions on ROWs and corridors, since the BLM's RFD for oil and gas, which provides estimated numbers of oil and gas wells and production, incorporates the restrictions on ROWs and corridors. Restrictions on new ROWs would tend to be a negligible factor in the decision to develop additional oil and gas wells in fields that are already producing, but may be an important factor in a decision to develop a new field.

Economic impacts related to other resources, such as locatable and salable minerals and renewable energy, are addressed outside the framework of the IMPLAN model. Impacts to economic conditions related to renewable energy management actions are described below for each alternative. For locatable and salable minerals, the BLM expects to meet market demand and respond to applications so that the production of these minerals would not vary across the alternatives being considered. Thus, the sections below on impacts under each alternative do not include earnings, jobs, or output related to locatable or salable minerals, such as bentonite. This does not mean production of these minerals or other activities not modeled in IMPLAN are unimportant (e.g., see Section 3.8.2 *Economic Conditions* in Chapter 3 for information on current employment and payroll from bentonite mining and processing). For more information on minerals, refer to Section 4.2.1 *Locatable Minerals* and Section 4.2.7 *Salable Minerals*.

Under all alternatives, the BLM generally expects to meet market demand and respond to applications for locatable minerals and mineral materials and does not anticipate that the production of these minerals would vary across the alternatives being considered. The different alternatives include varying restrictions on mineral entry and mineral materials disposal; however, restrictions may have a minor impact on overall economic conditions compared to current conditions.

Changes in economic activity have impacts on federal, state, and local tax revenues. While all sectors of the economy contribute to tax revenues, the analysis of tax revenue impacts focuses on oil and gas production because almost all of the measurable variation in economic activity among alternatives is related to oil and gas.

The focus of this analysis is on regional earnings and output, employment, and tax revenue, with the region defined as the four-counties in the Planning Area. The IMPLAN model is run at a regional (multi-county) scale, with the mathematical relationships that describe linkages between sectors aggregated to the four-county level. Because of this mathematical aggregation, it is not possible to identify total economic impacts for an individual community. For additional information on the structure of the IMPLAN model and specific assumptions made for the economic modeling analysis, refer to Appendix X, *Economic Impact Analysis Methodology*.

Alternative A

Impacts on Regional Earnings and Output

Based on the IMPLAN model, regional earnings under Alternative A for the modeled sectors (oil and gas, grazing, and recreation) would average approximately $75 million per year between 2007 and 2028, and regional output would average approximately $511 million per year, resulting from development and activities on BLM-administered land and mineral estate. The net present value of the stream of regional output, discounted at a 7 percent real discount rate (OMB 1992), would be approximately $5.8 billion over 20 years. Table 4-22 summarizes and compares sector-level breakouts for earnings and output by alternative.

Alternative A would maintain the current management approach of permitting renewable energy development on a case-by-case basis. This may result in adverse impacts by increasing uncertainty for individual firms considering developing renewable energy in the Planning Area.

The BLM generally expects to meet market demand for locatable minerals and mineral materials and respond to applications consistent with current management. Alternative A would maintain the current management approach with respect to leasing of BLM-administered lands for exploration and development, and may have little to no change compared to current conditions.

Table 4-22. Average Annual Impacts on Earnings and Output, by Sector and Alternative for the Planning Area

Sector	Alternative A	Alternative B	Alternative C	Alternative D
Impacts on Annual Average Earnings (millions of 2008 $)				
Oil and Gas	$66.5	$29.9	$74.9	$62.2
Livestock Grazing	$5.7	$4.1	$5.6	$5.7
Recreation	$2.9	$2.9	$2.9	$2.9
Total[2]	$75.0	$36.9	$83.4	$70.8
Impacts on Annual Average Output (millions of 2008 $)				
Oil and Gas	$481.2	$216.5	$542.2	$450.6
Livestock Grazing	$19.0	$13.7	$18.9	$19.0
Recreation	$11.1	$11.1	$11.1	$11.1
Total[2]	$511.3	$241.3	$572.3	$480.8
Impacts on Net Present Value of Output Over 20 Years (millions of 2008 $)[1]				
Oil and Gas	$5,483.5	$2,467.0	$6,178.8	$5,135.8
Livestock Grazing	$201.5	$157.0	$200.8	$201.4
Recreation	$114.9	$114.9	$114.9	$114.9
Total[2]	$5,799.9	$2,738.9	$6,494.5	$5,452.1

Source: Calculated using the IMPLAN model, as described in the text.
[1]Net present value from 2007 to 2028, discounted at 7 percent (rate from OMB 1992).
[2]Due to rounding, totals may not be additive.
IMPLAN Impact Analysis for Planning model

Impacts on Employment

Employment is a function of the level of economic activity (sales and purchases) among economic sectors. Thus, employment impacts are closely related to impacts on economic output. An increase in output implies an increase in employment and vice versa.

Based on the IMPLAN model, regional employment under Alternative A for the modeled sectors would average approximately 1,465 jobs per year between 2007 and 2028 due to activities on BLM-administered lands and mineral estate. The number of jobs is expressed as "annual job equivalents," where one annual job equivalent (AJE) represents 12 months of employment. For example, one AJE could represent two jobs for 6 months each, or one job for 12 months. AJEs may represent either full-time or part-time jobs. Table 4-23 provides a comparison of jobs by sector under the alternatives.

Average annual earnings per job would differ for each of these sectors, but would be the same under all alternatives. Based on the IMPLAN model, earnings per job (expressed in year 2008 dollars) would average:

- Between $52,000 and $62,000 for jobs in oil and gas well drilling and completion.
- Approximately $58,000 for jobs in oil and gas production.
- Approximately $30,000 for jobs associated with cattle and sheep grazing.
- Between $18,000 and $19,000 for recreation-related jobs.

Table 4-23. Average Annual Impacts on Employment, by Sector and Alternative for the Planning Area

	Number of Jobs[1]			
Sector	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
Oil and Gas	1,121	505	1,263	1,050
Direct	*578*	*260*	*651*	*541*
Indirect & Induced	*543*	*245*	*612*	*509*
Livestock Grazing	186	134	185	186
Direct	*106*	*77*	*106*	*106*
Indirect & Induced	*80*	*57*	*79*	*80*
Recreation	158	158	158	158
Direct	*131*	*131*	*131*	*131*
Indirect & Induced	*27*	*27*	*27*	*27*
Total[2]	1,465	796	1,606	1,393
Direct	*815*	*467*	*887*	*778*
Indirect & Induced	*650*	*329*	*719*	*616*

Source: Calculated using the IMPLAN model, as described in the text.
[1] Number of jobs is in annual job equivalents (AJE), where one AJE represents 12 months of employment. For instance, one AJE could represent one job for 12 months, or two jobs for 6 months.
[2]Due to rounding, totals may not be additive.
IMPLAN Impact Analysis for Planning model

Table 4-24 provides information on employment, disaggregated by economic sector, that would be associated with activities on BLM-administered land in each alternative. In each table cell, the first

figure is the comprehensive impact (including indirect and induced impacts from related sectors) and the second figure, in parentheses, is the direct impact only. In all alternatives, mining is the sector with greatest employment, most of it directly related to activities on BLM land. The other leading sectors are arts, entertainment, and recreation services; agriculture and agricultural services; retail trade; construction; and business services. With the exception of business services, all of these sectors would see contributions from both direct and indirect/induced activity.

Table 4-24. Average Annual Impacts on Employment, by Subsector and Alternative for the Planning Area

Sector	Number of Jobs[1] Total Contribution (Direct Contribution)2			
	Alternative A	Alternative B	Alternative C	Alternative D
Agriculture & Agricultural Services	140 (106)	100 (77)	139 (106)	139 (106)
Mining (includes oil and gas services)	517 (503)	233 (227)	582 (567)	484 (471)
Utilities	6 (0)	3 (0)	6 (0)	5 (0)
Construction	104 (32)	48 (14)	117 (36)	98 (30)
Manufacturing	12 (1)	6 (1)	13 (1)	11 (1)
Wholesale Trade	47 (27)	22 (12)	53 (30)	44 (25)
Retail Trade	123 (32)	78 (32)	133 (32)	118 (32)
Transportation & Warehousing	21 (0)	10 (0)	23 (0)	20 (0)
Information	10 (0)	6 (0)	12 (0)	10 (0)
Finance & Insurance	29 (0)	14 (0)	32 (0)	27 (0)
Real Estate & Rentals	56 (22)	28 (10)	62 (24)	53 (20)
Business Services (e.g., administrative)	97 (0)	48 (0)	108 (0)	92 (0)
Social Services	66 (0)	33 (0)	73 (0)	62 (0)
Arts/Entertainment/Recreation Services	156 (83)	120 (83)	163 (83)	152 (83)
Other Services	67 (13)	41 (13)	73 (13)	64 (13)
Institutions	15 (0)	7 (0)	17 (0)	14 (0)

Source: Calculated using the IMPLAN model. Due to rounding, totals may not match exactly the totals reported in other tables in this section.
[1] Number of jobs is in annual job equivalents (AJE), where one AJE represents 12 months of employment. For instance, one AJE could represent one job for 12 months, or two jobs for 6 months.
[2] The total contribution includes indirect and induced economic activity from related sectors (i.e., "upstream" and "downstream" sectors that supply materials and labor, or benefit from spending by workers in the sectors directly affected). For more information see the economic model description in the text.
IMPLAN Impact Analysis for Planning model

Impacts on Tax Revenue

Projected tax revenues for Alternative A resulting from oil and gas production on BLM-administered mineral estate would average $40.8 million per year for federal royalties, $19.6 million per year for state severance taxes, and $22.6 million per year for local ad valorem taxes. Because specific well locations are not known at this time, there is not sufficient data to apportion the local tax receipts to individual counties. Table 4-25 provides a summary and comparison of tax revenues from oil and gas production for the alternatives.

Table 4-25. Estimated Oil and Gas Tax Revenues by Alternative for the Planning Area (millions of 2008 $)

Tax Type	Alternative A	Alternative B	Alternative C	Alternative D
Federal mineral royalties	$40.8	$18.3	$45.9	$38.2
State severance taxes	$19.6	$8.8	$22.1	$18.3
Local ad valorem production taxes	$22.6	$10.2	$25.5	$21.2
Total[1]	**$83.0**	**$37.3**	**$93.5**	**$77.7**

Source: Calculated based on the IMPLAN model and state, federal, and local tax rates, as described in the text.
[1]Due to rounding, totals may not be additive.
IMPLAN Impact Analysis for Planning model

Alternative B

Impacts on Regional Earnings and Output

Based on the IMPLAN model, regional earnings under Alternative B for the modeled sectors (oil and gas, grazing, and recreation) would average approximately $37 million per year between 2007 and 2028, and regional output would average approximately $241 million per year, due to activities on BLM-administered land and mineral estate. The net present value of the stream of regional output, discounted at a 7 percent real discount rate (OMB 1992), would be approximately $2.7 billion over 20 years. Table 4-22 summarizes and compares sector-level breakouts for earnings and output by alternative.

Under Alternative B, 1,251,869 acres are renewable energy exclusion areas and an additional 1,691,497 acres are managed as avoidance/mitigation areas. Approximately 246,000 acres (7.7 percent of the Planning Area) would be open to renewable energy development. Alternative B could increase development in areas open to renewable energy development compared to Alternative A, since it would decrease uncertainty for firms considering developing renewable energy in the Planning Area. However, since there would be restrictions on renewable energy development in 90 percent of the Planning Area there would be less economic activity associated with renewable energy development under Alternative B compared to alternatives C and D.

Alternative B would limit or restrict the amount of land open to exploration and development of these minerals more than the other alternatives. However, restrictions may have a minor impact on overall economic conditions compared to current conditions.

Impacts on Employment

Based on the IMPLAN model, regional employment under Alternative B for the modeled sectors would average approximately 796 jobs per year between 2007 and 2028 due to activities on BLM-administered land and mineral estate. Alternative B would result in the least number of jobs compared to the other alternatives. Table 4-23 provides a comparison of jobs by sector under the alternatives.

Impacts on Tax Revenue

Projected tax revenues for Alternative B resulting from oil and gas production on BLM-administered mineral estate would average $18.3 million per year for federal royalties, $8.8 million per year for state severance taxes, and $10.2 million per year for local ad valorem taxes. Because specific well locations

are not known at this time, there is not sufficient data to apportion the local tax receipts to individual counties; however, the restrictions on oil and gas development under Alternative B affect broad areas of land throughout the Planning Area, so the reductions in tax revenues (relative to Alternative A) would affect virtually all communities that currently produce oil and gas. Table 4-25 provides a summary and comparison of tax revenues from oil and gas production for the alternatives. Implementation of Alternative B would result in the least amount of estimated oil and gas tax revenues compared to the other alternatives.

Alternative C

Impacts on Regional Earnings and Output

Based on the IMPLAN model, regional earnings under Alternative C for the modeled sectors (oil and gas, grazing, and recreation) would average approximately $83 million per year between 2007 and 2028, and regional output would average approximately $572 million per year, due to activities on BLM-administered land and mineral estate. The net present value of the stream of regional output, discounted at a 7 percent real discount rate (OMB 1992), would be approximately $6.4 billion over 20 years. Table 4-22 summarizes and compares sector-level breakouts for earnings and output by alternative.

Under Alternative C, approximately 151,506 acres renewable energy exclusion areas and 1,612,402 acres are avoidance/mitigation areas. Approximately 1.4 million acres (44 percent of the BLM-administered surface in the Planning Area) would be open to renewable energy development. Management of renewable energy under Alternative C could increase development compared to alternatives A and B, since it would reduce restrictions and open more area to renewable energy development. Similar to alternatives B and D, allocation of areas open to renewable energy could also increase renewable energy development by decreasing uncertainty for firms considering developing renewable energy in the Planning Area.

Alternative C would increase the amount of land open to exploration and development of locatable minerals and would slightly decrease the amount of land open to exploration and development of salable minerals compared to Alternative A (refer to Section 4.2 *Mineral Resources*). However, decreased restrictions and more areas open to mineral development may only have a minor impact on the regional economic conditions compared to current conditions.

Impacts on Employment

Based on the IMPLAN model, regional employment under Alternative C for the modeled sectors would average approximately 1,606 jobs per year between 2007 and 2028 due to activities on BLM-administered land and mineral estate. Alternative C would result in the greatest number of jobs compared to the other alternatives. Table 4-23 provides a comparison of jobs by sector under the alternatives.

Impacts on Tax Revenue

Projected tax revenues for Alternative C resulting from oil and gas production on BLM-administered surface would average $45.9 million per year for federal royalties, $22.1 million per year for state severance taxes, and $25.5 million per year for local ad valorem taxes. Because specific well locations are not known at this time, there is not sufficient data to apportion the local tax receipts to individual counties. Table 4-25 provides a summary and comparison of tax revenues from oil and gas production for the alternatives. Implementation of Alternative C would result in the greatest estimated oil and gas tax revenues compared to the other alternatives.

Alternative D

Impacts on Regional Earnings and Output

Based on the IMPLAN model, regional earnings under Alternative D for the modeled sectors (oil and gas, grazing, and recreation) would average approximately $71 million per year between 2007 and 2028, and regional output would average approximately $481 million per year, due to activities on BLM-administered land and mineral estate. The net present value of the stream of regional output, discounted at a 7 percent real discount rate (OMB 1992), would be approximately $5.5 billion over 20 years. Table 4-22 summarizes and compares sector-level breakouts for earnings and output by alternative.

Under Alternative D, 294,345 acres are renewable energy exclusion areas, and 2,501,876 acres are avoidance/mitigation areas. Approximately 393,593 acres (12 percent of the Planning Area) would be open to renewable energy development. Similar to alternatives B, C and D, allocation of areas open to renewable energy development under Alternative D could increase development in areas open to renewable energy since it would decrease uncertainty for firms considering developing renewable energy in the Planning Area.

Alternative D would increase the amount of land open to exploration and development of locatable minerals and the amount of land open to exploration and development of salable minerals compared to Alternative A (refer to Section 4.2 *Mineral Resources*). However, decreased restrictions and more areas open to mineral development may have only a minor impact on economic conditions compared to current conditions.

Impacts on Employment

Based on the IMPLAN model, regional employment under Alternative D for the modeled sectors would average approximately 1,393 jobs per year between 2007 and 2028 due to activities on BLM-administered land and mineral estate. Table 4-23 provides a comparison of jobs by sector under the alternatives.

Impacts on Tax Revenue

Projected tax revenues for Alternative D due to oil and gas production on BLM-administered surface would average $38.2 million per year for federal royalties, $18.3 million per year for state severance taxes, and $21.2 million per year for local ad valorem taxes. Because specific well locations are not known at this time, there is not sufficient data to apportion the local tax receipts to individual counties. Table 4-25 provides a summary and comparison of tax revenues from oil and gas production for the alternatives. Implementation of Alternative D would result in more estimated oil and gas tax revenues than Alternative B, but less than alternatives A and C.

4.8.3 Health and Safety

Health and safety, as discussed in this document, includes AMLs, natural geologic hazards, and hazardous wastes and materials. Each of these hazards is analyzed in this section.

Direct impacts to health and safety would result from management of AMLs, geologic hazards, and hazardous materials and wastes that increase the potential for and risk of accidents in the areas in which AMLs, geologic hazards, or hazardous waste and materials spills or releases occur. Indirect impacts result from management that results in potential impacts to health and safety in a different time and space in which the AML, geologic hazard, or hazardous spills occurs.

Adverse impacts result from management that increases the potential for accidents and risks to health and safety. Beneficial impacts result from management the decreases the risk or potential for accidents associated with AMLs, geologic hazards, or hazardous wastes and materials.

Short-term impacts result from management that affects health and safety within 5 years. Short-term impacts include impacts to health and safety at the site of a hazardous waste spill. Long-term impacts to health and safety are those that occur and result after a period of more than 5 years. Long-term impacts may include the accumulation of hazardous wastes in water, air, or other resources that would affect health and safety.

4.8.3.1 Methods and Assumptions

Assumptions used in this impact analysis include the following:

- Most AML sites in the Planning Area are identified and characterized.
- "The BLM will set as its highest AML physical safety action priority the cleaning up of those AML sites situated at locations: (a) where a death or injury has occurred and the site has not already been addressed; or (b) situated on or in immediate proximity to developed recreation sites and areas with high visitor use" (BLM 2000). AML sites adversely affecting watersheds are also a high priority. The BLM continues to support the Wyoming DEQ AML Division in reclaiming AML sites on public surface.
- No assumptions were identified for natural geologic hazards.
- All new hazardous materials and waste sites are identified and characterized.
- Resource development activities identify any possible generation of hazardous waste.
- No substantial new hazardous materials uses and/or waste generation occurs within the Planning Area.
- The BLM's Hazard Management and Resource Restoration Program responds to all hazardous material releases on public surface. Emergency cleanup actions are implemented on sites posing a substantial threat to the public and/or the environment.

4.8.3.2 Summary of Impacts by Alternative

Beneficial impacts to health and safety from management of AML sites occur under all alternatives; however, alternatives B and D would have the most beneficial impacts, followed by Alternative A, and then Alternative C. Under all alternatives, the BLM and Wyoming DEQ will identify and plan for remediation of AML sites which would reduce potential adverse impacts to health and safety. Alternative C could result in the greatest risk to health and safety from the management of AMLs by not prioritizing sites for reclamation and by allowing activities in mitigated AMLs.

Principle impacts to health and safety from geologic hazard areas would result from management that increases activities in geologic hazard areas and subsequently increases the risk and potential for accidents in these areas. Providing warning signs for geologic hazards would result in similar impacts under all the alternatives. Under Alternative A, there is no specific management for activities in geologic hazard areas, compared to the prohibition of activities under Alternative B, and allowing activities in mitigated geologic hazard areas under alternatives C and D. Adverse impacts to health and safety associated with geologic hazard management would be the least under Alternative B, followed by alternatives C and D, and greatest under Alternative A.

Under all alternatives, the impacts from management of hazardous wastes and materials would be the same. The potential for impacts may vary by alternative based on the level of mineral activity under the alternatives. Alternative C would result in the greatest amount of mineral activity, and as a result, may increase the generation, storage, and transport of hazardous materials, which could increase the potential for health and safety impacts compared to the other alternatives. Under all alternatives, an active remediation program remains in place and hazardous materials in the Planning Area are managed to reduce risk to people and the environment.

4.8.3.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Abandoned Mine Lands

To reduce the threat of physical and environmental impacts from AML sites, the BLM will remediate sites based on risk.

Long-term beneficial impacts to health and safety would result from the Wyoming DEQ, AML Division continuing work with the BLM to mitigate hazards associated with AML sites in the Planning Area.

Implementation of the alternatives is not anticipated to result in additional AML sites or increase the risks at AML sites that may adversely affect health and safety.

Natural Geologic Hazards

Natural geologic hazards in the Planning Area are managed to reduce risks to the public by providing warnings and, where appropriate, developing mitigation measures to avoid and minimize impacts associated with geologic hazards.

Implementation of the alternatives would not result in any increase in the potential for geologic hazards; however, management may decrease the risks and potential impacts to health and safety resulting from geologic hazards.

Developing a geologic hazards database that ranks threats to public health and safety, informing applicants and project proponents of geologic hazards, and developing mitigation may reduce impacts to health and safety from geologic hazards by providing resources that would reduce the risk to humans from geologic hazards.

Hazardous Wastes and Materials

Increases in human presence and activity associated with recreation, mineral activity, and ROW development increase risks associated with generation, use, transportation, and storage of hazardous wastes and materials. Mineral activities are the most likely activities to increase the risk of hazardous wastes and materials to health and safety.

Impacts to health and safety from the management of hazardous waste and materials would be the same under all alternatives as there are no separate management actions for hazardous waste the differ among the alternatives.

Implementing hazardous materials management activities will address human health and environmental risks from hazardous materials. Due to the increase in recreational activity throughout the Planning Area, particularly in areas such as Rattlesnake Ridge outside of Worland, and in proximity to oil and gas fields, H_2S poses an increasing threat to public health and safety. In order to reduce the risks to public health, all H_2S plans would comply with Onshore Order #6, which identifies “uniform national

requirements and minimum standards of performance expected from operators when conducting operations involving oil or gas that is known or could reasonably be expected to contain hydrogen sulfide." In addition, the BLM will mitigate safety concerns associated with H_2S through signs, warning sirens, and public education. All of these management actions would reduce the potential for human health and safety risks from H_2S. Any potential impacts to health and safety from H_2S would increase in relation to the level of mineral activity that releases H_2S.

Hazardous materials in the Planning Area are managed to reduce risks to visitors, employees, and the environment, to restore contaminated lands, and to carry out emergency-response activities, as per appropriate laws, policies, and regulations. Management to reduce risk and contamination would reduce potential impacts to health and safety from hazardous wastes. Substantive indirect impacts related to risks from hazardous materials during remediation could exist.

Preparing Environmental Site Assessments on lands acquired or conveyed and notifying the public of conveyance of public lands affected by hazardous substances would reduce the potential for health and safety impacts from hazardous wastes. The preparation of Environmental Site Assessments would also ensure that contaminated lands are not conveyed out of federal ownership in keeping with Comprehensive Environmental Response, Compensation and Liability Act and ensure that the BLM would not acquire contaminated lands.

Requiring Hazardous Spill Response Plans for all projects involving hazardous materials would reduce the potential for adverse impacts to health and safety. Hazardous Spill Response plans would provide a strategy for responding to hazardous materials spills that would reduce short-term health and safety impacts from spills. Reporting spills and releases of chemicals, petroleum products, and produced water to Wyoming DEQ would reduce the potential for both short-term and long-term impacts to health and safety by controlling spills and facilitating an appropriate response to hazardous materials spills.

Alternative A

Alternative A would result in direct beneficial impacts to health and safety by conducting inventory of hazards at AML sites and prioritizing sites for reclamation in coordination with Wyoming DEQ.

Allowing activities in AML areas on a case-by-case basis may result in adverse impacts to health and safety by increasing the potential for accidents and risks associated with activity in these areas.

Implementation of Alternative A would result in beneficial impacts to health and safety by providing warning signs for geologic hazards. Warning signs would identify hazards and reduce the potential for accidents associated with geologic hazards.

Alternative B

Under Alternative B, as under Alternative A, AML sites are inventoried for hazards and prioritized for reclamation in coordination with Wyoming DEQ. However, Alternative B has a greater beneficial impact compared to Alternative A by identifying AML sites with warning signage and erecting protective fencing around shafts and adits. Additionally, under Alternative B activities are prohibited within ¼ mile of AML areas to further reduce risk to health and safety compared to the other alternatives.

Identifying geologic hazard sites with warning signs would result in the same impact as described under Alternative A. However, inventorying geologic hazards and prohibiting activities in geologic hazard areas would reduce impacts to health and safety beyond Alternative A by further reducing the potential for accidents and health and safety risks in these areas.

Alternative C

Alternative C would result in fewer beneficial impacts than Alternative A by conducting inventory of AML sites but not prioritizing sites for reclamation. Additionally, allowing activities in mitigated AMLs may result in adverse impacts to health and safety by increasing the potential for accidents and risks associated with activities in these areas. Impacts associated with allowed activity in AMLs would be greater than the other alternatives.

Alternative C has fewer beneficial impacts than Alternative B but more than Alternative A by providing warnings for geologic hazards and identifying hazards on a case-by-case basis. Under Alternative C, activities are allowed in mitigated geologic hazard areas, which may result in adverse impacts to health and safety by increasing the potential for accidents and risks to health and safety in these areas compared to the other alternatives.

Alternative D

Management under Alternative D would inventory AML sites for hazards and erect warning signs and protective fencing in a similar fashion as Alternative B, resulting in similar beneficial impacts. Adverse impacts may result from allowing activities in AML areas, but requiring avoidance or mitigation may reduce the risk to human health and safety in these areas.

Safety measures taken to reduce the risks associated with geologic hazard sites would be the same as Alternative C, resulting in similar impacts.

4.8.4 Environmental Justice

This section addresses the potential for the alternatives to have disproportionate adverse impacts on minority and low-income populations, including direct, indirect, short-term, and long-term impacts. Laws, regulations, policies, and guidance considered in the analysis of disproportionate adverse impacts are identified in Appendix B.

Because the analysis of disproportionate adverse impacts depends on the impacts identified from management of resources, definitions of adverse impacts as they apply to environmental justice issues are closely related to the definitions of adverse impacts in other resource areas (e.g., social resources). For example, the displacement of a mobile home park that houses a low-income population in order to build a new road may be a disproportionate direct impact. An example of a disproportionate indirect impact would be a reduction in social services to low-income individuals that may result from decreased tax revenues as a result of decreased mineral production.

4.8.4.1 Methods and Assumptions

Since the analysis of disproportionate adverse impacts is based on other resource impacts, the assumptions for this analysis include the assumptions of other resource areas as they relate to the identification and analysis of impacts. In addition, this analysis assumes that the latest available demographic data from the United States Census and other sources accurately represent the population in the Planning Area.

In accordance with the BLM and CEQ guidance for assessing environmental justice in the planning process, an area is considered to contain a minority population if either the minority population of the impacted area exceeds 50 percent or the percentage of minority population in the impacted area is meaningfully greater than the percentage in the general population. The “general population” is defined as a relevant comparison area, such as the state.

The minority population in the four Planning Area counties ranges from 7 percent (Park, Hot Springs) to 17 percent (Washakie), compared with a state average of 14 percent. Only Washakie County has a higher minority population than the state. At the town level, two locations in Big Horn County (Burlington and Byron) and one town in Washakie County (Worland) have minority populations higher than the state average. These locations, and Washakie County generally, have a relatively high concentration of minority population, as defined in BLM and CEQ guidance (compared to the state).

In terms of low-income populations, in 2008 all four counties had a poverty rate of at least 10 percent, which is the state level. In 2000 (the latest year for which town-level data are available), at least one town in each county had a poverty rate higher than the state and only a few towns had a lower rate. Thus, there are concentrations of low-income populations within several regions of the Planning Area, as defined in BLM and CEQ guidance.

4.8.4.2 Summary of Impacts by Alternative

The alternatives would be identical with respect to potential impacts on minority and low-income populations. No particular BLM actions proposed in the alternatives would cause disproportionate adverse impacts on minority or low-income populations. The BLM has considered all input from persons regardless of their race, ethnicity, income status, or other social and economic characteristics.

4.8.4.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

The demographic conditions in the Planning Area indicate concentrations of low-income populations throughout the Planning Area, and concentrations of minority populations in the towns of Burlington, Byron, and Worland. However, there are no direct or indirect impacts of the alternatives that would impact these populations in a different way than the general population within the Planning Area. For example, the lower economic activity associated with Alternative B would cut across all sectors of the economy—from higher-skill managerial jobs to lower-skill service jobs. Thus, there would be no identifiable environmental justice issues or direct or indirect impacts associated with any of the alternatives that are specific to any minority or low-income community or population as defined in Executive Order 12898 or BLM IM 2002-164 (BLM 2002b).

While minority and low-income populations exist in the Planning Area, no particular BLM actions proposed in any of the alternatives have been identified as causing disproportionate adverse impacts on these populations.

Environmental justice guidance also requires that the BLM provides opportunities for people of all backgrounds to have a meaningful voice in the planning process. The BLM has provided numerous opportunities in a variety of different formats and has considered all input from persons regardless of their race, ethnicity, income status, or other social and economic characteristics. Refer to Chapter 5 for a description of public involvement activities associated with the RMP revision.

4.8.5 Tribal Treaty Rights

Adverse impacts to tribal treaty rights and trust responsibilities include, but are not limited to, limitations on access to tribal hunting, fishing, or resource collection areas reserved by treaty, economic issues, and other resource use and access issues. Beneficial impacts could include protection of culturally important archeological sites or sites of traditional or religious importance, and preservation of access to resources. Direct impacts are those that immediately affect resources, whether the impact

is to access of the resource or its physical condition. Indirect impacts are related to improved access and can take the form of loss of setting through increased visitation, or reduction in the availability of a plant or animal resource through loss of habitat or over-hunting.

Because archeological sites that may be of cultural importance are finite resources, short-term impacts are the same as long-term impacts. However, impacts to plant or animal resources may be mitigated through conservation plans.

Impacts are identified in consultation with the appropriate tribal groups. The CYFO and WFO coordinate and consult with appropriate Native American groups to identify and consider their concerns in BLM land use planning and decision-making. Interested tribes review proposed land use planning decisions and other major BLM decisions for consistency with tribal land use and resource allocation plans; however, no treaty rights pertain directly to BLM-administered lands within the Planning Area.

4.8.5.1 Methods and Assumptions

Although there are no tribal treaty rights within the Planning Area, the following three assumptions guide the approach to planning that may involve non-treaty Tribal issues.

- All tribally sensitive sites in the Planning Area have not been identified.
- Identification of tribally sensitive sites will benefit heritage resources.
- Tribal consultation benefits heritage resources.
- See Section 4.5.1 *Cultural Resources* for additional assumptions applicable to the impacts analysis for Tribal Treaty Rights.

4.8.5.2 Summary of Impacts by Alternative

There are no tribal treaty rights or trust responsibilities within the Planning Area and as such there are no differences in impacts between the alternatives. Under all alternatives, the BLM would continue to consult with interested tribes regarding issues of importance to the tribes.

4.8.5.3 Detailed Analysis of Alternatives

Impacts Common to All Alternatives

Because no tribal treaty rights or trust responsibilities are known within or mandated by the CYFO or WFO, management actions on the part of the BLM would have no impact on such rights. Each alternative has measures to protect cultural resources, including those related to traditional uses and practices; however, there are no differences among the alternatives in managing tribal treaty rights and trust responsibilities. These are discussed and analyzed in Section 4.5.1 *Cultural Resources* of this chapter. The BLM consults and coordinates with potentially affected tribes as part of the planning process and will continue to consult with interested tribes regarding resource management issues of interest to the tribes. In accordance with federal regulations and policy (e.g., NHPA) the BLM will consult with potentially affected tribes for site-specific actions under all alternatives.

4.9 Cumulative Impacts

The CEQ defines cumulative effects as:

> *The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7).*

The Bighorn Basin RMP Revision Project addresses the three components of this definition of cumulative effects as follows:

1. *Incremental impacts of the RMP revision*. The incremental impacts of the action (i.e., the revision of the three RMPs), are described for each resource in the preceding sections of this chapter as direct, indirect, short-term, and long-term impacts.
2. *Impacts from all past and present actions*. The impacts from past and present actions are captured in the baseline conditions presented in *Chapter 3 – Affected Environment*. As discussed in that chapter, the description of the current affected environment reflects past and present actions.
3. *Reasonably foreseeable future actions*. Other reasonably foreseeable future actions are identified in Appendix T and the total projected surface disturbance from these actions appears in the following section.

The analysis of cumulative impacts serves to place the projected incremental impacts from the proposed alternatives in the context of past, present, and future impacts. Combining the projected impacts of proposed alternatives with past, present, and future impacts necessarily involves projections and constrains analyses. Public documents prepared by federal, state, and local government agencies are the primary sources of information regarding past, present, and future actions. Speculative or uncommitted projects are not included in the projections. Analyses are limited, primarily due to incomplete documentation of all past and present impacts on private and public lands; challenges in predicting potential impacts for reasonably foreseeable future actions; the programmatic and strategic nature of proposed alternatives; the unknown nature and pace of resource uses and technological changes that could occur; and changing circumstances related to agency priorities, policies, and the economy. These limitations are addressed through the methods and assumptions described in the following section.

This section identifies 40 reasonably foreseeable future projects and actions in or adjacent to the Planning Area. The breakdown of the 40 projects by agency includes three BLM RMPs, one BLM Programmatic Wind Energy EIS, one BLM Programmatic Energy Distribution Corridor EIS, one BLM Programmatic Geothermal Leasing EIS, four County Land Use Plans, seven Conservation District Plans, six Watershed Plans, one Wyoming Department of Agriculture Strategic Plan, three Wyoming Game and Fish Department Plans, one Wyoming State Water Plan for the Wind/Bighorn River Basin, two Wyoming Statewide Outdoor Recreation and Trail Plans, one Wyoming State Historic Preservation Office Statewide Plan, one USFWS Plan, two NPS General Management Plans, one Wyoming State Plan, three County FMPs, one NPS FMP for Yellowstone National Park, and one National Fire Plan. Many of these plans have already been adopted, in which case the reasonably foreseeable actions stem from the ongoing implementation of the plans.

4.9.1.1 Methods and Assumptions

The CEQ suggests cumulative impact analyses should focus on meaningful impacts, and not exhaustively analyze all possible cumulative impacts (CEQ 1997b). Therefore, the analysis in this RMP and EIS focuses on past, present, and future actions anticipated to have environmental impacts similar to the kinds of impacts identified for implementing the alternatives including but not limited to those resulting in meaningful impacts to historically important resources, those with a potential for violating legal standards or laws, or other identified projects or actions in the geographic area of analysis (i.e., the Cumulative Impact Assessment Area [CIAA]) that relate to the identified cumulative impact issues.

To address the effects of these actions, the analysis is structured around a series of cumulative issue statements (described later in this section) that capture the major cumulative impacts in the CIAA. The BLM developed these issue statements using:

1. Issues identified during scoping.
2. Internal scoping (i.e., the professional judgment of BLM resource specialists and Cooperating Agencies).
3. A review of other reasonably foreseeable future actions in the CIAA.
4. Consideration of context and intensity of potential impacts.

For the cumulative impacts analysis, the BLM paid particular attention to: impacts to public health and safety; controversial issues or those with a substantial public interest; the uniqueness of resources affected; potential for violation of legal standards or laws; and potential impacts to legally protected resources.

To focus the scope of cumulative impact analysis, cumulative issues were considered in the context of baseline conditions (*Chapter 3 – Affected Environment*), the incremental impacts on individual resources described in this chapter, the actions and decisions described in the reasonably foreseeable future projects (Table 4-27), and the following factors as modified from the CEQ's *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997b):

- Does the affected resource have substantial value relative to legal protection and/or ecological, cultural, economic, or social importance?
- Are reasonably foreseeable future actions anticipated to have environmental impacts similar to the kinds of impacts identified for RMP alternatives?
- Have any recent or ongoing NEPA analyses of similar actions in the geographic area identified important adverse or beneficial cumulative impact issues?
- Has the impact to the resource been historically important, such that the importance of the resource is defined by past loss, past gain, or investments to restore resources?

The cumulative impact analysis was further bound by considering the following factors:

- *Timeframe* – Timeframes are based on the duration of the direct and indirect effects of the proposed action and alternatives (the life of the RMP for most issues).
- *Geographic area* – The geographic area of analysis, or the CIAA, covers different geographic areas depending on the specific resource being evaluated. For the most part, the CIAA is the Bighorn Basin (including the portions in Montana) except for 1) issues involving air quality, for which the CIAA will be the affected air sheds and nearby Class I areas; 2) water quality, particularly surface water, which will include drainage areas flowing into and out of the Planning

Area (e.g., Owl Creek, which turns into the Bighorn River); and, 3) social and economic conditions, for which the CIAA is the four counties that overlap the Planning Area.

- *Analytical assumptions* – see the Assumptions for Analysis below.

4.9.1.2 Assumptions for Analysis

The BLM used the following methods and assumptions in the analysis of cumulative impacts:

- Non-BLM oil and gas activities are based on the *Reasonable Foreseeable Development Scenario for Oil and Gas* (BLM 2009e).
- For the purposes of estimating surface disturbance from reasonably foreseeable actions, for non-BLM activities (excluding oil and gas), the amount and density of activities is generally assumed to be the same for BLM and non-BLM actions, regardless of land ownership. Appendix T contains further information on these assumptions and the acreage of projected surface disturbance by alternative from non-BLM actions. Specific assumptions include:
  - The cumulative impacts from non-BLM mineral actions (excluding oil and gas) are based on the percent BLM vs. non-BLM mineral estate in the Planning Area.
  - The cumulative impacts from other non-BLM development activities are based on the percent BLM vs. non-BLM-administered surface in the Planning Area.
- The context and intensity of non-BLM activities are not anticipated to vary by alternative because these activities do not directly depend on management actions and allowable uses set forth in the RMP alternatives.
- Cumulative impacts, such as soil erosion, spread of invasive species, and habitat fragmentation, are anticipated to increase with the amount of surface disturbance (Table 4-26).
- Actions undertaken by private persons and entities are captured in public documents prepared by federal, state, and local government agencies.
- For the estimation of air quality emissions, the context and intensity of non-BLM activities are not anticipated to vary by alternative. Additionally emissions from projects used to analyze cumulative impacts on air quality from non-BLM oil and gas activities were estimated using data on existing and projected oil and gas wells in the Planning Area from the *Reasonable Foreseeable Development Scenario for Oil and Gas* (BLM 2009e) and a similar methodology to that described in Appendix U. The BLM estimates that on private and fee (i.e., non-federal) land in the Planning Area, there are 201 existing conventional gas wells and 1,342 existing oil wells. At the end of the planning cycle, the BLM projects the drilling of 511 new oil and gas wells on non-federal mineral estate in the Planning Area (BLM 2009e). The BLM used this information to estimate emissions from oil and gas wells for the 2015 and 2024 emission projection years. For natural gas emissions, cubic feet of natural gas produced during the planning cycle on non-federal mineral estate was estimated using expected natural gas production in 2015 and 2024 from projected federal wells in the Planning Area.
- For cumulative impacts associated with other activities (i.e., non-oil and gas), the amount and density of activities is assumed to be the same for both BLM and non-BLM actions; therefore, the analysis of non-BLM salable and locatable mineral activities is based on the proportional mineral estate ownership in the Planning Area (74 percent federal and 26 percent non-federal). The calculation of cumulative impacts for air quality from non-mineral, non-BLM activities is based on the proportion of surface ownership in the Planning Area (56 percent BLM-administered and 44 percent non BLM-administered). Alternative A continues management under the existing plans and is, therefore, assumed to provide the best baseline from which to

estimate future emissions for non-BLM actions. Since the context and intensity of non-BLM actions are not anticipated to vary by alternative, the emissions from non-BLM actions estimated under Alternative A were carried forward under alternatives B, C, and D.

The majority of projects identified in Table 4-27 are programmatic and/or strategic in nature; therefore, the exact intensity or location of anticipated impacts cannot be quantified. For more quantitative analysis, the BLM projected the anticipated surface disturbance and air emissions from non-BLM reasonably foreseeable actions for the entire Planning Area (Appendix T). The estimates of reasonably foreseeable actions in Appendix T are based on historic and trend information, as well as the proportion of public to non-public land in the Planning Area. In addition to estimating reasonably foreseeable actions for BLM and non-BLM actions, Appendix T also projects short-term and long-term surface disturbance. Long-term surface disturbance describes the disturbed area remaining following reclamation. Table 4-26 summarizes projected surface disturbance for BLM and non-BLM reasonably foreseeable actions identified in Appendix T.

Where appropriate, analyses of historic and current trends are used to assess cumulative impacts. For example, the subdividing of private land in rural areas is expected to continue in the future.

Table 4-26. Cumulative Surface Disturbance in Acres from BLM and Non-BLM Reasonably Foreseeable Actions

Action	Alternative A	Alternative B	Alternative C	Alternative D
Total Acres Short-Term Disturbance from BLM Actions	136,415	73,919	245,783	140,508
Total Acres Reclaimed from BLM Actions	120,705	63,037	204,238	122,065
Total Acres Long-Term Disturbance from BLM Actions	15,710	10,882	41,545	18,443
Total Acres Short-Term Disturbance from Non-BLM Actions	24,129	26,048	24,154	24,129
Total Acres Reclaimed from Non-BLM Actions	14,494	16,494	14,494	14,494
Total Acres Long-Term Disturbance from Non-BLM Actions	9,635	9,555	9,660	9,636
Cumulative Long-Term Acres from Disturbance	25,346	20,436	51,206	28,079

Source: Appendix T
BLM Bureau of Land Management

Most projects identified in Table 4-27 are ongoing and provide a management framework for site-specific actions implemented during the life of the various projects. Though they are considered in this cumulative impacts analysis, refer to Chapter 3 – *Affected Environment*, for a detailed description of site-specific past and present (i.e., ongoing) actions. Only those reasonably foreseeable future actions resulting from the 40 projects identified in Table 4-27 and Appendix T are considered in this cumulative impacts analysis.

Table 4-27. Summary of Reasonably Foreseeable Future Actions

Resource Plans	**Physical Resources**	Air Quality	Geology	Soil	Water	Cave and Karst Resources	**Mineral Resources**	**Fire and Fuels Management**	**Biological Resources**	**Heritage and Visual Resources**	Cultural Resources	Paleontological Resources	Visual Resources	**Land Resources**	Lands and Realty	Renewable Energy	Rights-of-Way and Corridors	Travel and Transportation Management	Recreation	Lands with Wilderness Characteristics	Livestock Grazing Management	**Special Designations**	ACECs	Scenic or Back Country Byways	National Historic Trails	Wild and Scenic Rivers	Wilderness Study Areas	**Socioeconomic Resources**	Social Conditions	Economic Conditions	Health and Safety	Environmental Justice	Tribal Treaty Rights
BLM RESOURCE MANAGEMENTS PLANS AND OTHER FEDERAL PLANS AND ANALYSES																																	
Approved Resource Management Plan for Public Lands Administered by the Bureau of Land Management Buffalo Field Office Final Environmental Impact Statement (BLM 2001a)		X	X	X	X		X	X	X	X	X		X		X		X	X	X		X		X				X		X	X	X	X	
Final Resource Management Plan/Environmental Impact Statement for the Lander Resource Area (BLM 1986b)		X	X	X	X		X	X	X	X	X		X		X		X	X	X		X		X				X		X	X	X	X	
Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States (BLM 2005d)																X	X																
Final Environmental Impact Statement Resource and Management Plan Billings Resource Area, 1983		X	X	X	X		X	X	X	X	X		X		X		X	X	X		X		X				X		X	X	X	X	
DOE and BLM. 2008. Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States (DOE/EIS-0386)																X	X																
BLM and USFS (U.S. Forest Service). 2008. Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States							X																										
COUNTY PLANS																																	
Big Horn County Land Use Plan		X	X	X	X		X		X				X		X		X				X								X	X			
Hot Springs County Land Use Plan		X			X		X		X		X	X	X						X		X		X			X	X				X		
Park County Land Use Plan				X	X				X		X		X		X		X													X			
Washakie County Land Use Plan		X			X		X		X		X	X						X	X		X						X				X		

Table 4-27. Summary of Reasonably Foreseeable Future Actions (Continued)

Resource Plans	**Physical Resources**	Air Quality	Geology	Soil	Water	Cave and Karst Resources	**Mineral Resources**	**Fire and Fuels Management**	**Biological Resources**	**Heritage and Visual Resources**	Cultural Resources	Paleontological Resources	Visual Resources	**Land Resources**	Lands and Realty	Renewable Energy	Rights-of-Way and Corridors	Travel and Transportation Management	Recreation	Wilderness Characteristics	Livestock Grazing Management	**Special Designations**	ACECs	Scenic or Back Country Byways	National Historic Trails	Wild and Scenic Rivers	Wilderness Study Areas	**Socioeconomic Resources**	Social Conditions	Economic Conditions	Health and Safety	Environmental Justice	Tribal Treaty Rights
CONSERVATION DISTRICTS																																	
South Big Horn CD Long Range Plan					X				X												X												
Hot Springs County CD Plan				X	X				X												X												
Meeteetse CD Land Use Management and Resource Conservation Plan 2010		X		X	X		X	X	X		X	X	X			X	X	X	X		X	X							X	X			
Cody CD Long Range Plan				X	X				X																								
Shoshone CD Plan				X	X			X											X		X												
Powell Clarks Fork Conservation District Plan			X	X					X										X		X												
Washakie County CD Plan			X	X	X				X		X								X		X												
WATERSHED PLANS																																	
Big Horn River Watershed Plan					X			X	X									X	X		X										X		
South Big Horn County, Wyoming Watershed Plan					X		X		X										X		X										X		
Greybull Watershed Draft Plan					X																												
Shoshone Water Management Plan 2006				X	X				X									X	X		X								X	X	X		
Shoshone River Watershed Plan Draft 2008				X	X				X									X	X		X								X	X	X		
Bitter Creek Watershed Plan					X				X												X										X		
STATE AGENCY PLANS																																	
Wyoming Dept. of Agriculture Strategic Plan 2005																					X												
Wyoming Game and Fish Strategic Habitat Plan									X										X		X												
Wyoming Game and Fish Greater Sage-Grouse Conservation Plan				X	X		X		X										X		X												
Wyoming Game and Fish Final Wyoming Gray Wolf Management Plan 2007									X																								

Table 4-27. Summary of Reasonably Foreseeable Future Actions (Continued)

Resource Plans	**Physical Resources**	Air Quality	Geology	Soil	Water	Cave and Karst Resources	**Mineral Resources**	**Fire and Fuels Management**	**Biological Resources**	**Heritage and Visual Resources**	Cultural Resources	Paleontological Resources	Visual Resources	**Land Resources**	Lands and Realty	Renewable Energy	Rights-of-Way and Corridors	Travel and Transportation Management	Recreation	Wilderness Characteristics	Livestock Grazing Management	**Special Designations**	ACECs	Scenic or Back Country Byways	National Historic Trails	Wild and Scenic Rivers	Wilderness Study Areas	**Socioeconomic Resources**	Social Conditions	Economic Conditions	Health and Safety	Environmental Justice	Tribal Treaty Rights
Wyoming State Water Plan Wind/Bighorn River Basin 2003					X						X					X			X		X												X
Wyoming Statewide Comprehensive Outdoor Recreation Plan (2003)																		X	X														
Wyoming Statewide Trails Plan 2004																		X	X						X		X						
Wyoming SHPO Comprehensive Statewide Historic Preservation Plan 2007-2015											X		X																				
FEDERAL AGENCY PLANS																																	
Shoshone National Forest Plan		X		X	X		X	X	X										X	X	X					X	X		X	X			
Bighorn National Forest Plan			X	X	X		X	X	X		X		X					X	X	X	X												
United States Fish and Wildlife Service Wyoming Plan					X				X																								
United States EPA Region 8 Wyoming State Implementation Plans		X											X																				
FIRE MANAGEMENT PLANS																																	
Yellowstone National Park Fire Management Plan		X						X	X		X																						
Big Horn County Mountain Community Wildfire Protection Plan								X	X																								
Park County Community Wildlife Protection Plan								X	X																								
Washakie County Community Wildfire Protection Plan								X	X																								
National Fire Plan				X				X	X																								

ACECs Areas of Critical Environmental Concern
BLM Bureau of Land Management
CD Conservation District
Dept. Department
EPA Environmental Protection Agency
SHPO State Historic Preservation Office

4.9.1.3 Cumulative Impacts

The cumulative impacts discussion is organized according to the following six cumulative issues:

Cumulative Issue 1: The cumulative impact on air quality with regard to public health and welfare within the Planning Area and protected Class I areas outside the Planning Area.

Cumulative Issue 2: The cumulative impact of surface-disturbing and other activities that affect vegetation cover on water quality.

Cumulative Issue 3: The cumulative impact of management actions on habitat for wildlife and special status wildlife species, including greater sage-grouse.

Cumulative Issue 4: The cumulative impact of management actions on global climate change.

Cumulative Issue 5: Cumulative impacts of management actions and constraints on recreation opportunities.

Cumulative Issue 6: The cumulative impact of management actions and projected development on the economic and social conditions of local communities.

To focus the cumulative impact analysis, the BLM determined the six cumulative issues by using the approach described under Methods and Assumptions. Review of the EISs and associated plans for all 40 projects (Table 4-27) revealed that most reasonably foreseeable actions could be expected to produce environmental impacts similar to the incremental impacts identified for the RMP alternatives. Some resources (i.e., special status species, air quality) that could be affected by reasonably foreseeable future actions have substantial value relative to legal protection and/or ecological, economic, or social importance. Exceeding legal standards or thresholds protecting these resources is not anticipated from the cumulative impacts of BLM and non-BLM actions; however, the programmatic nature of most reasonably foreseeable actions prohibits precise prediction of cumulative impacts. As a result, subsequent environmental impact analysis during project implementation will include more detailed and site-specific analyses of cumulative impacts.

Cumulative Issue 1: The cumulative impact on air quality with regard to public health and welfare within the Planning Area and protected Class I areas outside the Planning Area.

Cumulative Impact Assessment Area

The Bighorn Basin and federal Class I areas within 100 miles.

Analysis of Cumulative Impacts

Base year (2005) and anticipated annual air emissions by alternative for project years 2015 and 2024 are organized by project scenario and resource as shown in Tables 4-30 through 4-38 (tables located at the end of *Cumulative Impacts)*. These tables identify each anticipated emission category for projected BLM actions, projected non-BLM actions, and the cumulative total of these actions.

Typical sources contributing to potential cumulative impacts on air quality would include emissions from conventional oil and gas development, vehicle operations associated with mining activities, and general vehicular activity from local residents and tourism. In addition, open burning of agricultural fields, which is a traditional practice in the CIAA, would, along with wildland fires and prescribed burns, result in impacts on air quality from emissions of particulates and polyaromatic hydrocarbons and temporarily

reduce visibility in areas. Permitted stationary sources of air emissions, such as the Western Sugar factory in Lovell, Wyoming would also continue to contribute to cumulative impacts on air quality.

Overall, air quality in the Bighorn Basin is good. Some concentrated emission sources may have health impacts to certain local residents. The *Washakie County Comprehensive Plan* notes that a number of emission sources in the county contribute to poor air quality which can disproportionately impact the county's senior and disabled population, who are more susceptible to dust and smoke than the general population (Washakie County 2004). Local policy that encourages land use and development that does not result in new, significant deteriorations of existing air quality would help to maintain current air quality, reduce air quality degradation, and protect public health. However, increases in population would likely bring more development and the potential for more emission sources that could degrade air quality in the Bighorn Basin.

BLM and non-BLM reasonably foreseeable actions are anticipated to increase emissions in the Planning Area over the life of the plan. For the Planning Area, the cumulative air quality impacts (as measured against NAAQS and WAAQS) are anticipated to have the same intensity on BLM- and non BLM-administered lands because it is assumed the density of activities are the same in both areas. This conclusion also assumes that cumulative impacts to air quality are equally distributed across the CIAA. Because of proposed development restrictions on BLM-administered land, the potential for adverse cumulative impacts to air quality are anticipated to be the least under Alternative B, followed by alternatives D and A. Cumulative emissions are projected to be highest under Alternative C due to fewer proposed development restrictions on BLM-administered land. Cumulative emissions within the Planning Area are not anticipated to result in air quality impacts that exceed NAAQS or WAAQS given the rather small amount of emissions (relative to other portions of the state of Wyoming where significant development is predicted) from BLM and other activities. The only exception may be ozone. The nearest ozone monitor to the Planning Area is located well outside of the Bighorn Basin, but showed levels close to the current standard (see Chapter 3 for additional information). However, the lack of available data makes it impossible to say with any certainty whether an exceedance of the standard would occur under any of the alternatives.

Cumulative Issue 2: The cumulative impact of surface-disturbing and other activities that affect vegetation cover on water quality.

Cumulative Impact Assessment Area

The Bighorn Basin and the reaches of Owl Creek.

Analysis of Cumulative Impacts

The *Soil, Water,* and *Biological Resources - Vegetation* sections in this chapter describe how surface disturbances, changes in vegetation cover, and other activities affect water quality by increasing or decreasing sediment loads in waterways or otherwise affecting water quality. In general, the more surface disturbance that occurs across the CIAA, the greater the potential impact to water quality. Adverse impacts to water quality would result from both short- and long-term disturbances, even though a majority of the area where surface disturbance is projected to occur on both BLM-administered land and state and private lands would be reclaimed. Sediment loading is of particular concern in Bighorn Lake, which provides for municipal and industrial water supplies and is a major recreation destination (USACE and BOR 2009).

Surface Water Quality

In the CIAA, stream-bank degradation and erosion and gully erosion, due to poor vegetative cover and surface disturbances, are the predominant sources of excessive sediment in waterways. On BLM-administered and private and state lands, surface disturbance caused by mineral and other development, the construction and maintenance of ROWs, and vegetation treatments (e.g., prescribed burns and mechanical fuels treatments) all contribute to short- or long-term losses of vegetation and increased sedimentation. In addition to surface-disturbing activities, impacts to water quality can result from a variety of other activities that can damage or remove vegetation and soil (e.g., improperly managed livestock grazing, OHV recreation, surface discharge of produced water, and concentrated use of riparian areas by wildlife). Sediment loading, along with other water quality issues such as the introduction of fecal coliform bacteria, occurs from private lands in the CIAA due to agricultural activities (e.g., irrigation runoff) and urban and rural subdivision development (Washakie County Conservation District 2006). Even given the high natural background sediment production in the Planning Area (USACE and BOR 2009; Washakie County Conservation District 2006), the South Big Horn Conservation District (2006) notes, "although flow from the rangelands and deserts contribute the majority and peak suspended sediment discharges to the rivers, irrigation wastewater significantly increases the sediment load in streams." The cumulative impacts of BLM and non-BLM actions on water quality would likely be most pronounced along waterbodies with impaired water quality, such as those on the Wyoming DEQ's 303(d) list (Wyoming DEQ 2008). The conditions of these waterbodies are partially linked to upland conditions, and they can carry large amounts of sediment downstream when surface flows occur.

As Table 4-26 shows, cumulative surface-disturbance acreage is projected to be highest under Alternative C and the lowest under Alternative B; Appendix T includes a breakdown of disturbance by activity. Proper management of surface-disturbing and other activities that can damage vegetation cover in the CIAA—through the application of guidance, such as the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for the Public Lands Administered by the BLM in the State of Wyoming* (Appendix N) on BLM-administered lands, or BMPs, such as those found in the *National Range and Pasture Handbook* and *The Wyoming Forestry Best Management Practices: Forestry BMPs Water Quality Protection Guidelines* on private lands (Appendix L)—would lessen sediment loading and associated adverse impacts to water quality. The application of BMPs on private land is not required in many instances and, therefore, their application would likely be inconsistent across the CIAA. In addition, the management under each RMP alternative (see Chapter 2 *Resource Management Alternatives*) protects BLM-administered lands via restrictions on surface-disturbing and other activities and reclamation requirements of disturbed areas. This management would vary by alternative and would not apply to lands under state and private ownership. The scale and effectiveness of this protective management would be greatest under Alternative B, where the focus is on resource protection, and lowest under Alternative C, where the focus is on resource use and commodity production. As a result, cumulative impacts to water quality due to sediment loading are anticipated to be the most under Alternative C, followed by alternatives A, D, and B. However, even with the proper application of relevant guidelines, BMP, and restrictive management of resource uses across the CIAA, impacts to water quality from human activity would still continue to occur under all alternatives.

Programs related to education and coordination by Conservation Districts and county zoning regulations that attach minimum lot sizes to residential development may reduce sediment loading of streams in the CIAA. However, if trends associated with the subdivision of larger ranches into ranchettes continues across the Planning Area, and predicted population trends for Park and Big Horn counties occur (see Section 3.8.1 *Social Values*), increased building (e.g., residences or barns) and infrastructure construction, and the associated expansion of impermeable surfaces across the CIAA may lead to

additional sediment loading of waterways. Depending on factors such as the type of development and the sediment contribution of the land use it replaces (e.g., agricultural rotational crops), such impacts may be beneficial.

Produced water from oil and gas development is regulated by the Wyoming DEQ, which establishes standards for water quality parameters such as total dissolved solid loads. Proper application of Wyoming DEQ water quality standards (Wyoming DEQ 2002) would lessen the potential for the introduction of water not meeting effluent limits, but this additional water would still result in adverse impacts to stream banks and gully erosion from altered flow regimes. The limited surface discharge of produced water anticipated in the Planning Area would limit the scale of these impacts.

Riparian Areas

In addition to general impacts from surface disturbance, BLM and non-BLM actions that affect riparian/wetland areas can result in substantial impacts to bank stability and the ability of vegetation to capture sediment and other water quality contaminants (see Section 3.1.4 *Water*). The majority of the surface lands along major waterways in the CIAA (i.e., the Bighorn River, Wind River, Clarks Fork of the Yellowstone River, and their associated tributaries, including the Nowood, Greybull, and Shoshone river systems) are privately owned. Of the 139,052 acres of riparian/wetland areas in the Planning Area, only 24,036 acres (17 percent) occur on BLM-administered surface. The large percentage of riparian/wetland areas on private lands means that actions by private landowners can have substantial impacts on the health of these systems and their performance of critical water quality protection functions. Programs and projects, such as those by County Conservation Districts, the National Resource Conservation Service, and county weed and pest districts, have had success in the implementation of proactive measures to improve riparian habitat and other vegetation and water sources (South Big Horn Conservation District 2007; Lumley et al. 2010). To manage riparian/wetland areas that occur on BLM-administered lands, alternatives A, B, and D apply proactive management measures that prohibit surface-disturbing activities in these areas and require active management of these to meet, or make progress towards meeting, PFC, DFC, or DPC. Management actions under alternatives B, D, A, and C would result in fewer beneficial impacts, respectively, to BLM-administered riparian/wetland areas. Actions by other entities to protect and restore riparian areas in the CIAA, coupled with protective management under alternatives B, D, or A may reduce cumulative adverse impacts to water quality by restoring functioning conditions in riparian areas. Such improvement would continue the current trend for these areas (see Section 3.3.3 *Vegetation – Riparian/Wetland Resources*).

Groundwater

The quality and quantity of groundwater in the CIAA is of concern as this water source makes up the majority of the municipal and residential water supply (South Big Horn Conservation District 2006; Big Horn County 2009). Alternatives proposed as part of this RMP revision would have impacts on groundwater through actions that allow or prohibit mineral development. In addition, municipal, mining, agricultural, and industrial use of this resource on state and private lands in the CIAA would affect groundwater quantity. Contamination of this resource from wastewater treatment and septic systems (Big Horn County 2009) and improper reinjection of produced water from oil and gas development are the principle groundwater quality concerns in the CIAA.

To limit adverse impacts to groundwater quality from wastewater, counties within the Planning Area are attempting to implement zoning restrictions and county level planning, such as the protection of sensitive groundwater areas in the Big Horn County Land Use Plan (Big Horn County 2009) through requiring larger residential lot sizes to reduce the concentration of wastewater discharge. Additionally, wells used for the reinjection of produced water require a permit from the Wyoming DEQ for

construction and operation to insure the reinjected water does not enter into water bearing strata or resurface elsewhere. Though oil and gas development on state and private lands in the Planning Area is not anticipated to vary by alternative, Alternative C is projected to result in the greatest number of new federal oil and gas wells and, therefore, the greatest potential for cumulative adverse impacts to groundwater, followed by alternatives A, D, and B.

Cumulative Issue 3: The cumulative impact of management actions on habitat for wildlife and special status wildlife species, including greater sage-grouse.

Cumulative Impact Assessment Area

The Bighorn Basin.

Analysis of Cumulative Impacts

The condition of wildlife and special status wildlife species habitat is described in Chapter 3 – *Affected Environment*, and potential impacts to wildlife habitat from BLM-actions are described in Section 4.4 *Fish and Wildlife Resources - Wildlife* and Section 4.4 *Special Status Species - Wildlife* sections in this chapter.

Cumulative impacts on wildlife habitat would result primarily from surface-disturbing and other disruptive activities such as mineral development, road construction, vegetation treatments, rangeland improvements, and urban and rural expansion. These activities would result in short- and long-term impacts to wildlife habitat that may degrade and fragment habitat. Management actions to address the challenges associated with wildlife habitat impacts are listed by alternative in Chapter 2. Regardless of the alternative, the general approaches these management actions take to reduce impacts to wildlife habitat are the prohibition or restriction of certain resource uses and activities on BLM-administered land to control surface-disturbing and disruptive activities. These restrictions are generally applied to the following types of activities: oil and gas development, geophysical exploration, mineral materials disposal, renewable energy and ROW authorizations, and motorized vehicle use. Generally, the more surface disturbance and habitat loss from BLM actions, the greater the contribution to cumulative adverse impacts to wildlife and special status wildlife species. Of all the alternatives, Alternative C places the fewest restrictions on resource uses and surface-disturbing activities and would, therefore, result in the greatest adverse impacts to wildlife and special status wildlife species habitat.

Primary challenges for wildlife habitat management within BLM-administered land include poor habitat conditions, fire management, drought, increased development and urbanization, habitat fragmentation, OHV misuse, disease, hunter access, and the impacts of livestock grazing management on the frequency, quality, and composition of key forage species (see Chapter 3 *Affected Environment* for more information). The challenges associated with impacts to wildlife habitat are anticipated to continue under all alternatives. Additionally, surface-disturbing activities, wildfires, spread of invasive species, and activities that remove vegetation are anticipated to impact wildlife habitat regardless of land ownership. Wildlife habitat impacts from non-BLM actions in the CIAA are primarily anticipated from urban and energy development and associated infrastructure (e.g., roads, pipelines, powerlines), although the intensity of development on private lands is not expected to vary by alternative.

As noted in Chapter 3, many wildlife populations spend considerable time on non BLM-administered lands and are therefore proportionately impacted by the management of these lands. Important wildlife habitat such as migration corridors and parturition and crucial winter ranges extend across the patchwork of land ownership in the CIAA. For example, the Planning Area contains 2,417,631 acres of

big game crucial winter range, of which 47 percent is on non BLM-administered lands (BLM 2009a). Surface disturbance and other development (e.g., oil and gas) on these lands are not subject to the same restrictions designed to protect wildlife habitat on BLM-administered land and may increase the cumulative impacts on wildlife habitat. Given the varied land ownership pattern, protecting large blocks of intact habitat is a management challenge in the CIAA. The WGFD has, as part of its *Strategic Habitat Plan*, developed strategies to implement partnerships/projects with private landowners and land management agencies to preserve and restore habitat at the watershed or landscape level across land ownership boundaries (WGFD 2001). Within the Shoshone and Bighorn National Forests, wildlife specific management would protect habitat along the edges of the basin. For example, in the Bighorn National Forest Plan, the USFS applies seasonal restrictions on motorized travel routes to reduce disturbance in key big game areas such as birthing areas and winter ranges (USFS 2005a).

Increased residential development and an expanded network of roads in portions of the CIAA may contribute to a reduction in suitable wildlife habitat. While the majority of population growth would likely occur in population centers where most of the job opportunities exist, such as in Cody, Powell, and Worland, rural development may have a greater proportional impact if the development occurs near sensitive wildlife habitat. In Washakie County, for example, the rural population increased by approximately 17 percent during the 1990s, accompanied by an increase in the number of second homes in and against the mountains where much of the big game crucial winter range occurs (Washakie County 2004). The trend in second home development is not isolated to Washakie County, occurring along the mountains in other parts of the Bighorn Basin, and would result in an increase in cumulative impacts on wildlife and their habitat. Additionally, the practice of subdividing larger private parcels to support development of residential subdivisions and ranchettes (e.g., 35-acre parcels) is expected to continue and contribute to wildlife habitat impacts (Big Horn County 2009). As larger tracts of land adjacent to public lands are subdivided, the WUI and its associated effects (e.g., habitat degradation and fragmentation, fire suppression, and spread of invasive species) are expected to increase. Some tracts of BLM-administered land may become disconnected or isolated from other native habitats and ultimately adversely affect CIAA biological diversity. In addition, with multiple land owners in the WUI, management of resources and resource uses affecting wildlife habitat, including invasive species spread, fire, wildlife, livestock grazing, motorized vehicle use, and development are expected to be varied.

Oil and gas development would result in one of the greatest impacts to wildlife habitats. While reclamation and mitigation procedures would reduce the short-term impact from surface disturbance associated with oil and gas development, permanent facilities such as roads and well pads would result in long-term impacts. Cumulative impacts would be greater where mineral development is more intense, such as in Oil and Gas Management Areas designated under alternatives C and D, and on state and private land where fewer protections for habitat exist. Impacts would also be greater where oil and gas activity occurs in and around sensitive wildlife habitat such as crucial winter range. For example, several producing oil and gas fields overlap big game crucial winter range on private and state land along the Absaroka Front on the western edge of the Bighorn Basin. Cooperative management among landowners and the BLM in accordance with the Absaroka Front HMP would help to reduce the impacts to wildlife associated with mineral development in this area (BLM 1986a).

In general, cumulative impacts to special status wildlife species habitat would be the same as those for wildlife habitat. Surface-disturbing activities would tend to degrade and fragment habitat, having a greater impact where sensitive habitat and development occur. For example, many raptor nests occur near riparian areas, such as the Bighorn River corridor, where recreation and private development are common. On federal land, special status wildlife species would be protected by site-specific mitigation

under the ESA and Wyoming BLM sensitive species guidance. However, on private and state lands, protection of non-federally listed species may not occur.

Cumulative impacts to greater sage-grouse habitat would result from surface-disturbing and other disruptive activities that result in loss of habitat and bird displacement. Restrictions that limit resource uses in greater sage-grouse habitat on BLM-administered land would reduce habitat loss, but would not prevent further habitat destruction from occurring on non BLM-administered land. Greater sage-grouse habitat on private and state lands would not receive the same level of protection and may result in greater habitat degradation. However, the core areas identified by the WGFD would help to limit development that may cause a decline in greater sage-grouse populations on state land (Wyoming Office of the Governor 2008). Applying resource constraints to limit disturbances within these core areas will protect suitable habitat for greater sage-grouse in the CIAA, reducing overall cumulative impacts to the species.

The greatest impacts on greater sage-grouse habitat would likely occur from mineral development and vegetation treatments that can remove large areas of sagebrush and increase the spread of invasive species. Impacts due to other factors such as hunting, predation, and farming may occur, but the scope of the impact would generally be smaller. For example, according to the *Wyoming Greater Sage-Grouse Conservation Plan*, farming areas make up only about 1.5 million acres in Wyoming, or 2.5 percent of the land area and currently only limited areas are being converted from sagebrush habitats to farmlands (Wyoming Sage-grouse Working Group 2003).

Cumulative impacts to wildlife and special status wildlife species habitat are anticipated to be least under Alternative B, which provides the most measures to minimize wildlife habitat loss and fragmentation and closes the most wildlife habitat to oil and gas development in the CIAA, followed by alternatives D, A, and C. The greatest adverse cumulative impacts to wildlife habitat are anticipated under Alternative C because this alternative allows the most development with the least restrictions to address wildlife habitat conservation on BLM-administered lands. For this analysis, habitat impacts from non-BLM actions are assumed not to vary across alternatives. In addition, habitat impacts from non-BLM actions on private lands may be greater than impacts on public lands based on the fact that privately held lands are subject to fewer restrictions and generally experience more development compared to public lands.

Cumulative Issue 4: The cumulative impact of management actions on global climate change.

Cumulative Impact Assessment Area

Global.

Analysis of Cumulative Impacts

The lack of scientific tools (models with sufficient spatial and temporal resolution) to forecast climate change even at regional scales limits the ability to quantify effects of current and future management on global climate change. Given this current state of climate change science, it is not yet possible to associate specific actions with specific impacts in a given area. As a result, a discussion of incremental impacts on climate change resulting from BLM actions when added to other past, present, and reasonably foreseeable future actions is not possible.

However, when added to past, present, and reasonably foreseeable future actions, the alternatives would result in overall differences in GHG emissions and contributions to climate change. Due to the

lack of information for GHG emissions from past, present, and reasonably foreseeable future actions, cumulative impacts are analyzed qualitatively among the alternatives comparing management that would likely affect global climate change. Alternative C would result in the greatest cumulative impacts to climate change resulting from the most oil and gas development, the most surface disturbance, the least restrictions on livestock grazing, and the highest amount of fossil fuel combustion from motor vehicles, compared to the other alternatives. Alternative B would result in the least cumulative impacts to climate change due to the least amount of oil and gas development, the least projected surface disturbance, the most restrictions on livestock grazing, and the most conservation of biological resources that retain sequestered carbon and minimize emissions. Alternative D would result in greater cumulative impacts to climate change than Alternative B, less than Alternative C, and similar impacts to Alternative A (see Tables 4-3 and 4-4).

Implementation of the alternatives and other reasonably foreseeable future actions in the Planning Area would produce GHG emissions resulting in a minor contribute to climate change. As an indication of the scale of this contribution, projected CO_2 emissions in 2018 resulting from BLM activities (Table 4-3) would result in approximately 0.5 percent of 2005 CO_2 emissions in Wyoming (CCS 2007) and 0.005 percent of total 2008 CO_2 emissions in the U.S. (EPA 2010). Any noticeable effects of climate change in any given area result from the cumulative aggregation of all worldwide GHG emissions, global climate patterns, and other forces. As a result, the cumulative impacts to climate change resulting from BLM management and other past, present, and reasonably foreseeable future actions in the Planning Area would likely have no measurable effect on global climate change.

Cumulative Issue 5: Cumulative impacts of management actions and constraints on recreation opportunities.

Cumulative Impact Assessment Area

The Bighorn Basin, plus the BLM Billings Field Office, Montana.

Analysis of Cumulative Impacts

Recreation (Section 4.6.5) and *Comprehensive Travel and Transportation Management* (Section 4.6.4) describe how management actions under each alternative affect recreation opportunities in the Planning Area. As with direct and indirect impacts, cumulative impacts would most likely occur from surface-disturbing activities (primarily related to minerals development), which change recreational settings, and from constraints, which limit access and recreational motorized vehicle use.

Resource development and surface-disturbing activities (e.g., oil and gas development, fire and fuels management) on BLM-administered lands and private and state lands can result in increased visual intrusions, noise, and visitor contacts that interfere with realizing desired beneficial outcomes and displace recreational users from their desired setting-specific areas. Recreationists seeking undisturbed landscapes are particularly affected by surface disturbance, especially in back country and primitive recreation settings. While much of this activity would be mitigated or avoided on BLM-administered lands regardless of the alternative, many of the restrictions discussed in this RMP do not apply to private and state lands in the CIAA. Cumulative impacts to recreation would therefore be greatest at the intersection of primitive or back country recreation areas and private lands, especially in areas where mineral potential or urban development potential is highest. Alternative B would result in the least cumulative surface disturbance and protects the most area suitable for primitive recreation (via LWCs, WSRs, and recreation management areas), followed by alternatives D, A, and C. As discussed under Cumulative Issue 3, cumulative impacts to wildlife can result from mineral and residential development

(particularly in areas where such development overlaps important wildlife habitat). Development may displace big game populations, resulting in adverse impacts to opportunities for hunting, a major recreation activity in the Planning Area. Though management under the RMP cannot dictate management on private and state lands, protecting habitat on BLM-administered lands would benefit hunting across the CIAA by protecting important life-cycle (i.e., parturition) habitat for game species and thus insuring their continued presence. Alternative B would result in the smallest loss of wildlife habitat and the greatest benefits from proactive management actions in the CIAA (e.g., closing areas to oil and gas development), followed by alternatives D, A, and C respectively.

Potential long- and short-term cumulative impacts to recreation may also occur from land use restrictions established to protect sensitive resources. Development activities that improve legal access to public lands, establish new and improve existing roads, and increase opportunities for motorized travel may benefit recreational experiences for motorized vehicle (OHV) recreationists. Alternative C would be the most effective at increasing motorized recreation opportunities, followed by alternatives A, D, and B. Increasing resource use and development may increase traffic on some roads and trails and increase the potential for long-term conflicts between commercial and recreational use of these roads. Conflict may also occur if development on private lands adjacent to BLM-administered lands includes sensitive noise receptors (i.e., second home development or rural subdivisions); such development would likely occur regardless of the RMP alternative. Construction of pipelines, fences, and transmission lines would increase hazards to recreational motorized vehicle users and reduce public safety in certain areas. Management that results in a decrease in the amount of area available to motorized vehicle use on BLM-administered lands would be greatest under Alternative B, followed by alternatives D, A, and C. The availability of motorized recreation opportunities on private and state land is not anticipated to vary by alternative; however, increased access on adjacent BLM-administered lands may lead to increased use of non-BLM lands or, conversely, closing areas of BLM-administered land to motorized vehicles may displace these users to private or state lands.

Cumulative Issue 6: The cumulative impact of management actions and projected development on the economic and social conditions of local communities.

Cumulative Impact Assessment Area

The assessment area for cumulative social and economic conditions consists of the four counties that overlap the Planning Area.

Analysis of Cumulative Impacts

Analysis in this section primarily focuses on cumulative impacts related to oil and gas activity, ranching and livestock grazing, and quality of life, including nonmarket values.

The impacts of oil and gas drilling and production described in Section 4.8.2 *Economic Conditions* relate to activities only on BLM-administered surface and federal mineral estate within the Planning Area. However, oil and gas activity on private and state land is estimated to constitute a substantial portion of projected oil and gas activity in all alternatives (see Table 4-28 below). Specifically, in Alternative A, oil and gas drilling and production on state and private land would comprise about 31 percent of total activity; in Alternative B, about 50 percent; in Alternative C, about 28 percent; and in Alternative D, about 32 percent. Note that the percentage is greatest in Alternative B. The implication of this is that the activity on state and private land would partially mitigate the relatively lower oil and gas production on federal lands under Alternative B as compared to the other alternatives. The overall change in earnings, employment, and output would be proportionally smaller than the reduction in activity on

federal lands would suggest. To see this, note that the analysis earlier in Chapter 4 showed $66.5 million in earnings and 1,121 jobs related to oil and gas drilling, completion, and production in Alternative A, and $30 million in earnings and 505 jobs for the same activities in Alternative B – a 55 percent reduction. The comparable figures incorporating state and private production are $96 million and 1,621 jobs for Alternative A, and $59.5 million and 1,004 jobs for Alternative B – a 38 percent reduction. While the reduction from Alternative A to B would still be substantial, the stability of state and private production would moderate the change in federal policy.

Table 4-28. Cumulative (including state and private) Impacts of Oil and Gas Development over the Life of the Plan in the Planning Area for Economic Conditions

Impact[1]	Alternative A	Alternative B	Alternative C	Alternative D
Annual Average Earnings	$96.1	$59.5	$104.5	$91.8
Annual Average Output	$695.8	$431.1	$756.8	$665.3
Net Present Value of Output	$7,929.8	$4,912.9	$8,625.3	$7,582.1
Annual Average Employment[2]	1,621	1,004	1,763	1,549
Change from Alternative A – Earnings	N/A	-$36.5	$8.4	-$4.2
Change from Alternative A – Employment	N/A	-616	+142	-71
Percentage change from Alternative A (earnings, employment)	N/A	-38%	+9%	-4%
Percentage change from Alternative A (earnings, employment), for federal land only	N/A	-55%	+13%	-6%

Source: Calculated using the IMPLAN model, as described in the text. Includes oil and gas well drilling and completion, and production from new wells, as estimated in the BLM's Reasonable Foreseeable Development Scenario for federal, state, and private land.
[1]All dollar values are in millions of year 2008 dollars. Net present value of output is discounted at a 7-percent real discount rate, as recommended in OMB 2002.
[2]Employment is in annual job equivalents.
BLM Bureau of Land Management
IMPLAN Impact Analysis for Planning model
N/A not applicable

Similarly, the effect of oil and gas activities on state and private land moderates the changes in earnings and employment for alternatives C and D. In Alternative C, oil and gas activity on federal lands would create 13 percent more jobs and earnings than Alternative A, but incorporating state and fee lands would reduce this effect to a 9 percent increase. In Alternative D, oil and gas activity on federal lands would create 6 percent fewer jobs and earnings than Alternative A, but incorporating state and fee lands would reduce this effect to a 4 percent decrease.

Under each alternative various management actions constrain mineral development on BLM-administered land for the protection of other resource values. These constraints can limit the mineral development activity on BLM-administered surface and mineral estate and constrict the minerals-based economy in the Planning Area. Table 4-29 summarizes the number of constrained federal wells and unconstrained non-federal wells for each alternative over the life of the plan.

Table 4-29. Reasonable Foreseeable Development Well Number Projections

Well Type	Alternative A	Alternative B	Alternative C	Alternative D
Number of Projected New Federal Wells	1,130	509	1,257	1,032
Projected Number of Abandoned New Federal Wells	217	98	243	201
Projected Productive New Federal Wells	**913**	**411**	**1,014**	**831**
Number of Projected New Non-federal Wells	511	511	511	511
Projected Number of Abandoned New Non-federal Wells	98	98	98	98
Projected Productive New Non-federal Wells	**413**	**413**	**413**	**413**
Cumulative New Wells (Federal and Non-federal)	1,641	1,020	1,768	1,543
Cumulative Abandoned New Wells (Federal and Non-federal)	315	196	342	299
Cumulative Productive New Wells (Federal and Non-federal)	**1,326**	**824**	**1,426**	**1,244**

Source: BLM 2009e

The projected number of cumulative productive new wells is greatest under Alternative C (1,426) and the least under Alternative B (824). The percent increase/decrease from the number of new wells under Alternative A follows.

- Alternative B – 38 percent decrease
- Alternative C – 8 percent increase
- Alternative D – 6 percent decrease

Increasing energy development and mining for mineral resources is likely to have a substantial social and economic impact within the Planning Area. As noted in the *Economic Conditions* section of this chapter, Alternative C is anticipated to result in the most substantial increase of economic opportunities with the highest projected job growth for the Planning Area followed by alternatives A, D, and B. Regional employment under Alternative C is also anticipated to average the greatest number of full and part-time jobs per year related to the oil and gas, livestock grazing, and recreation industries, which may result in beneficial impacts on quality of life. However, Alternative C may also result in adverse impacts to air quality, wildlife, and other resources that improve quality of life related to natural characteristics as priorities would be placed on the use of resources such as oil and gas development over the conservation of resources such as air quality and wildlife.

Comparatively, Alternative B would provide the least economic and social benefits as measured by jobs and income; priorities under this alternative are centered on conservation of land and existing environmental conditions. Alternative D would result in more opportunities than Alternative B, but fewer economic and social opportunities than Alternative C and Alternative A; the latter essentially represents the continuation of current trends. However, Alternative D would continue BLM's current practice of allowing multiple uses, balancing the use of resources such as oil and gas reserves with the conservation of resources such as air quality, open space, and wildlife range areas while providing an increase in job opportunities dispersed geographically across the Planning Area. Overall, Alternative D updates BLM's land and resource management guidelines in the Planning Area while preserving both job opportunities and nonmarket values associated with open space and the environment.

Past, present, and reasonably foreseeable future actions in the Planning Area and surrounding geographic areas would also affect both traditional economic measures (earnings, jobs, output) and nonmarket values in the Planning Area. For example, the BLM Lander Field Office RMP, which is being updated concurrent with the CYFO and WFO RMPs, would update BLM's direction and management plans in the Lander Field Office, which includes some land in Hot Springs County as well as several neighboring counties. Thus, the choice of alternatives in the Lander RMP could directly affect social and economic conditions in the Planning Area for the Bighorn Basin RMP. However, based on past BLM actions and present policy of balanced management of land and resources, the combined effects within the Planning Area – either on traditional economic measures or nonmarket values – would not likely be different from those under alternatives A, B, C, and D in this planning effort.

A combination of market conditions and state and federal policy related to ranching and livestock grazing in Wyoming, and across the Rocky Mountain West, has created adverse economic conditions for many farms and ranches in the Planning Area. BLM management actions have the potential to help mitigate the effects of past and present trends that make livestock grazing more challenging, or to exacerbate those trends and further reduce the opportunities for livestock grazing operators. For example, some ranch owners raise money for retirement or other purposes by subdividing portions of their land into ranchettes and selling them to individuals. The sale of these ranchettes provides financial liquidity to ranchers who frequently have most of their assets in land, but generally results in increased building of fences, houses, and sometimes other structures (e.g., barns), changing the character of the landscape. Under all alternatives, this trend is likely to continue, because it is fundamentally related to (1) the nature of the ranching business (principally, the fact that most ranchers' assets are in land, and the fact that profit margins are generally low and can turn negative in drought or other adverse conditions) and (2) state laws that govern property subdivision, under which county zoning laws cannot regulate subdivisions of 35 acres and larger. However, RMP alternatives that adversely affect the profitability of ranching could serve to increase this trend. Specifically, Alternative B would have an adverse impact on continued profitability of livestock operators, and under this alternative, the subdivision, sale, and development of ranchettes could accelerate. This would result in a substantial cumulative impact, and the contribution of the BLM action would be cumulatively considerable. Alternatives A, C and D would not be expected to exacerbate this cumulative impact.

Under all alternatives, however, potential cumulative impacts on livestock grazing operations could also result from a combination of activities and land uses occurring within the Planning Area primarily from surface-disturbing activities, human disturbances, and the presence of wildlife that compete with livestock for rangeland resources. Additionally, any increases in human population relative to increased job growth could create additional demands for recreational use of the public lands and could result in livestock displacement, increases in noxious weed infestation, and costs to operators and public land management areas. (However, only Alternative C would result in increased job growth compared to the current trend, and the increase would be small.)

Despite the potential for cumulative impacts resulting from various operations in the Planning Area, overall cumulative impacts of BLM and non-BLM actions are not anticipated to have long-term adverse impacts on livestock grazing on public lands, since anticipated impacts to grazing lands will occur gradually over the life of the plan, except in Alternative B where the impacts of livestock grazing withdrawals would be substantial for the reasons noted above. Additionally, the implementation of BLM's mitigation guidelines, reclamation requirements, surface use restrictions, rangeland guidelines, vegetation treatments, and monitoring efforts would provide protection to forage resources on federal lands, which would help reduce overall impacts on livestock grazing resources and operations.

Table 4-30. Cumulative Annual Emissions for BLM Activities within the Bighorn Basin Planning Area - Baseline Year 2005

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	43.51	16.42	59.93	14.79	5.58	20.37	184.58	69.66	254.24	0.74	0.28	1.01
Oil Development/Production	178.74	67.46	246.20	39.67	14.97	54.65	786.82	296.95	1,083.77	103.83	39.19	143.02
Locatables	1,407.26	494.44	1,901.70	154.68	54.35	209.03	83.98	29.51	113.49	0.18	0.06	0.24
Salable Minerals	338.62	118.97	457.59	35.07	12.32	47.39	17.71	6.22	23.93	0.06	0.02	0.09
Resource Roads	79.97	62.83	142.81	8.76	6.88	15.64	4.63	3.64	8.27	0.02	0.02	0.04
ROW and Corridors	0.31	0.24	0.55	0.04	0.03	0.08	0.28	0.22	0.51	0.00	0.00	0.00
Livestock Grazing	12.71	9.98	22.69	1.85	1.46	3.31	0.78	0.61	1.39	0.00	0.00	0.01
Renewable Energy	59.40	46.67	106.08	8.69	6.83	15.51	1.58	1.24	2.81	0.01	0.01	0.01
Fire Management	333.83	262.30	596.13	48.55	38.15	86.70	3.02	2.37	5.39	0.01	0.01	0.02
Forest and Woodlands	22.30	17.52	39.83	3.21	2.52	5.73	0.27	0.21	0.48	0.00	0.00	0.00
Vegetation Management	2.04	1.61	3.65	0.30	0.23	0.53	0.01	0.01	0.02	0.00	0.00	0.00
Vegetation – Invasive Species	0.04	0.03	0.06	0.04	0.03	0.06	0.69	0.54	1.23	0.00	0.00	0.01
Off-Highway Vehicles	28.21	22.16	50.37	25.95	20.39	46.34	16.21	12.74	28.95	2.99	2.35	5.34
Total	**2,506.93**	**1,120.64**	**3,627.58**	**341.60**	**163.74**	**505.34**	**1,100.56**	**423.93**	**1,524.48**	**107.85**	**41.94**	**149.79**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	227.46	85.85	313.31	1,037.22	391.46	1,428.67	112.98	42.64	155.62
Oil Development/Production	201.46	76.03	277.49	25.32	9.56	34.87	2.53	0.96	3.49
Locatables	17.95	6.31	24.26	2.89	1.02	3.91	0.29	0.10	0.39
Salable Minerals	7.56	2.66	10.21	1.24	0.43	1.67	0.12	0.04	0.17
Resource Roads	0.98	0.77	1.76	0.38	0.30	0.69	0.04	0.03	0.07
ROW and Corridors	0.13	0.11	0.24	0.02	0.02	0.04	0.00	0.00	0.00
Livestock Grazing	0.31	0.24	0.55	0.06	0.04	0.10	0.01	0.00	0.01
Renewable Energy	0.70	0.55	1.25	0.09	0.07	0.17	0.01	0.01	0.02
Fire Management	13.74	10.80	24.54	6.64	5.22	11.86	0.66	0.52	1.19
Forest and Woodlands	1.02	0.80	1.82	0.34	0.27	0.61	0.03	0.03	0.06
Vegetation Management	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.35	0.27	0.62	0.05	0.04	0.10	0.01	0.00	0.01
Off-Highway Vehicles	2,247.63	1,765.99	4,013.62	1,069.10	840.00	1,909.10	0.00	0.00	0.00
Total	**2,719.30**	**1,950.39**	**4,669.69**	**2,143.35**	**1,248.43**	**3,391.78**	**116.68**	**44.34**	**161.02**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-31. Cumulative Annual Emissions Associated with Alternative A - Project Year 2015

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	47.22	21.85	69.07	16.29	8.03	24.32	202.33	98.34	300.66	0.80	0.38	1.19
Oil Development/Production	187.92	80.35	268.27	39.97	15.12	55.10	764.16	255.31	1,019.47	100.83	33.68	134.51
Locatables	1,512.45	531.40	2,043.85	165.27	58.07	223.34	58.03	20.39	78.42	0.19	0.07	0.26
Salable Minerals	338.30	118.86	457.16	34.75	12.21	46.96	7.84	2.76	10.60	0.06	0.02	0.09
Resource Roads	79.78	62.68	142.46	8.56	6.73	15.29	0.32	0.25	0.56	0.02	0.02	0.04
ROW and Corridors	5.94	4.67	10.61	0.69	0.55	1.24	1.47	1.15	2.62	0.03	0.02	0.05
Livestock Grazing	12.68	9.97	22.65	1.83	1.44	3.27	0.11	0.08	0.19	0.00	0.00	0.01
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.19	0.15	0.34	0.01	0.01	0.01
Fire Management	333.77	262.25	596.02	48.49	38.10	86.58	1.03	0.81	1.84	0.01	0.01	0.02
Forest and Woodlands	22.29	17.51	39.80	3.19	2.51	5.70	0.14	0.11	0.24	0.00	0.00	0.00
Vegetation Management	2.21	1.74	3.95	0.31	0.25	0.56	0.01	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	12.94	10.17	23.11	1.33	1.05	2.38	0.27	0.22	0.49	0.00	0.00	0.01
Off-Highway Vehicles	26.58	20.88	47.46	24.45	19.21	43.66	37.52	29.48	67.00	4.29	3.37	7.65
Project Year 2015 Total	**2,641.45**	**1,188.97**	**3,830.42**	**353.79**	**170.04**	**523.84**	**1,073.41**	**409.05**	**1,482.47**	**106.25**	**37.58**	**143.83**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	255.08	133.58	388.65	984.33	493.86	1,478.19	108.04	54.38	162.42
Oil Development/Production	196.40	66.53	262.93	24.63	8.28	32.91	2.46	0.83	3.29
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	5.54	1.95	7.49	0.83	0.29	1.12	0.08	0.03	0.11
Resource Roads	0.10	0.08	0.18	0.15	0.12	0.26	0.01	0.01	0.03
ROW and Corridors	1.80	1.42	3.22	0.29	0.23	0.52	0.03	0.02	0.05
Livestock Grazing	0.16	0.13	0.29	0.03	0.03	0.06	0.00	0.00	0.01
Renewable Energy	0.30	0.23	0.53	0.06	0.05	0.11	0.01	0.00	0.01
Fire Management	11.75	9.23	20.99	4.89	3.84	8.73	0.49	0.38	0.87
Forest and Woodlands	0.41	0.32	0.74	0.09	0.07	0.16	0.01	0.01	0.02
Vegetation Management	0.02	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.60	0.47	1.08	0.06	0.05	0.11	0.01	0.00	0.01
Off-Highway Vehicles	2,420.75	1,902.02	4,322.77	908.02	713.44	1,621.46	0.00	0.00	0.00
Project Year 2015 Total	**2,905.44**	**2,120.38**	**5,025.82**	**1,925.31**	**1,220.93**	**3,146.25**	**111.34**	**55.74**	**167.08**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-32. Cumulative Annual Emissions Associated with Alternative A - Project Year 2024

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	54.21	24.18	78.39	19.14	8.98	28.12	235.98	109.57	345.55	0.93	0.43	1.36
Oil Development/Production	226.06	96.05	322.11	44.32	16.95	61.28	773.05	259.58	1,032.63	101.92	34.20	136.12
Locatables	1,512.45	531.40	2,043.85	165.27	58.07	223.34	58.03	20.39	78.42	0.19	0.07	0.26
Salable Minerals	338.30	118.86	457.16	34.75	12.21	46.96	7.84	2.76	10.60	0.06	0.02	0.09
Resource Roads	79.78	62.68	142.46	8.56	6.73	15.29	0.32	0.25	0.56	0.02	0.02	0.04
ROW and Corridors	5.94	4.67	10.61	0.69	0.55	1.24	1.47	1.15	2.62	0.03	0.02	0.05
Livestock Grazing	12.68	9.97	22.65	1.83	1.44	3.27	0.11	0.08	0.19	0.00	0.00	0.01
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.24	0.18	0.42	0.01	0.01	0.01
Fire Management	333.77	262.25	596.02	48.49	38.10	86.58	1.03	0.81	1.84	0.01	0.01	0.02
Forest and Woodlands	22.30	17.52	39.82	3.21	2.52	5.72	0.14	0.11	0.25	0.00	0.00	0.00
Vegetation Management	2.21	1.74	3.95	0.31	0.25	0.56	0.01	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	12.94	10.17	23.11	1.33	1.05	2.38	0.27	0.22	0.49	0.00	0.00	0.01
Off-Highway Vehicles	18.67	14.67	33.34	17.18	13.50	30.67	55.44	43.56	99.00	4.79	3.76	8.55
Project Year 2024 Total	**2,678.68**	**1,200.80**	**3,879.49**	**353.73**	**167.12**	**520.85**	**1,133.92**	**438.66**	**1,572.58**	**107.97**	**38.54**	**146.50**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	307.26	150.96	458.22	816.54	375.07	1,191.62	91.60	42.33	133.93
Oil Development/Production	199.51	67.88	267.38	25.13	8.52	33.65	2.51	0.85	3.37
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	5.54	1.95	7.49	0.83	0.29	1.12	0.08	0.03	0.11
Resource Roads	0.10	0.08	0.18	0.15	0.12	0.26	0.01	0.01	0.03
ROW and Corridors	1.80	1.42	3.22	0.29	0.23	0.52	0.03	0.02	0.05
Livestock Grazing	0.16	0.13	0.29	0.03	0.03	0.06	0.00	0.00	0.01
Renewable Energy	0.41	0.32	0.73	0.07	0.05	0.12	0.01	0.01	0.01
Fire Management	11.75	9.23	20.99	4.89	3.84	8.73	0.49	0.38	0.87
Forest and Woodlands	0.81	0.64	1.45	0.16	0.12	0.28	0.02	0.01	0.03
Vegetation Management	0.02	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.60	0.47	1.08	0.06	0.05	0.11	0.01	0.00	0.01
Off-Highway Vehicles	2,190.14	1,720.83	3,910.97	622.72	489.28	1,112.01	0.00	0.00	0.00
Project Year 2024 Total	**2,730.63**	**1,958.32**	**4,688.95**	**1,472.81**	**878.28**	**2,351.10**	**94.96**	**43.72**	**138.68**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-33. Cumulative Annual Emissions Associated with Alternative B - Project Year 2015

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	40.06	21.85	61.91	14.57	8.03	22.60	178.97	98.34	277.30	0.70	0.38	1.08
Oil Development/Production	144.70	80.35	225.05	27.35	15.12	42.48	464.16	255.31	719.47	61.23	33.68	94.91
Locatables	1,512.45	531.40	2,043.85	165.27	58.07	223.34	58.03	20.39	78.42	0.19	0.07	0.26
Salable Minerals	324.18	118.86	443.05	33.27	12.21	45.48	7.53	2.76	10.29	0.06	0.02	0.08
Resource Roads	60.62	62.68	123.31	6.51	6.73	13.24	0.24	0.25	0.49	0.02	0.02	0.03
ROW and Corridors	4.13	4.67	8.80	0.48	0.55	1.03	1.02	1.15	2.17	0.02	0.02	0.04
Livestock Grazing	11.95	9.97	21.92	1.76	1.44	3.20	0.05	0.08	0.14	0.00	0.00	0.00
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.19	0.15	0.34	0.01	0.01	0.01
Fire Management	166.88	262.25	429.13	24.24	38.10	62.34	0.51	0.81	1.32	0.01	0.01	0.02
Forest and Woodlands	14.63	17.51	32.14	2.11	2.51	4.62	0.08	0.11	0.19	0.00	0.00	0.00
Vegetation Management	4.28	1.74	6.02	0.61	0.25	0.86	0.01	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	6.47	10.17	16.64	0.67	1.05	1.72	0.16	0.22	0.37	0.00	0.00	0.01
Off-Highway Vehicles	26.58	20.88	47.46	24.45	19.21	43.66	37.52	29.48	67.00	4.29	3.37	7.65
Project Year 2015 Total	**2,376.30**	**1,188.97**	**3,565.27**	**309.93**	**170.04**	**479.97**	**748.48**	**409.05**	**1,157.53**	**66.52**	**37.58**	**104.10**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	240.33	133.58	373.90	851.24	493.86	1,345.10	93.92	54.38	148.30
Oil Development/Production	120.89	66.53	187.42	15.05	8.28	23.33	1.51	0.83	2.33
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	5.32	1.95	7.27	0.79	0.29	1.08	0.08	0.03	0.11
Resource Roads	0.08	0.08	0.16	0.11	0.12	0.23	0.01	0.01	0.02
ROW and Corridors	1.28	1.42	2.70	0.21	0.23	0.44	0.02	0.02	0.04
Livestock Grazing	0.08	0.13	0.21	0.02	0.03	0.04	0.00	0.00	0.00
Renewable Energy	0.30	0.23	0.53	0.06	0.05	0.11	0.01	0.00	0.01
Fire Management	5.88	9.23	15.11	2.45	3.84	6.29	0.24	0.38	0.63
Forest and Woodlands	0.44	0.32	0.76	0.09	0.07	0.16	0.01	0.01	0.02
Vegetation Management	0.04	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.32	0.47	0.79	0.04	0.05	0.09	0.00	0.00	0.01
Off-Highway Vehicles	2,420.75	1,902.02	4,322.77	908.02	713.44	1,621.46	0.00	0.00	0.00
Project Year 2015 Total	**2,808.21**	**2,120.38**	**4,928.59**	**1,780.01**	**1,220.93**	**3,000.94**	**96.00**	**55.74**	**151.74**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-34. Cumulative Annual Emissions Associated with Alternative B - Project Year 2024

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	44.25	24.18	68.43	16.28	8.98	25.26	199.16	109.57	308.73	0.78	0.43	1.20
Oil Development/Production	172.95	96.05	269.01	30.64	16.95	47.60	471.80	259.58	731.38	62.16	34.20	96.36
Locatables	1,512.45	531.40	2,043.85	165.27	58.07	223.34	58.03	20.39	78.42	0.19	0.07	0.26
Salable Minerals	324.18	118.86	443.05	33.27	12.21	45.48	7.53	2.76	10.29	0.06	0.02	0.08
Resource Roads	60.62	62.68	123.31	6.51	6.73	13.24	0.24	0.25	0.49	0.02	0.02	0.03
ROW and Corridors	4.13	4.67	8.80	0.48	0.55	1.03	1.02	1.15	2.17	0.02	0.02	0.04
Livestock Grazing	11.95	9.97	21.92	1.76	1.44	3.20	0.05	0.08	0.14	0.00	0.00	0.00
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.24	0.18	0.42	0.01	0.01	0.01
Fire Management	166.88	262.25	429.13	24.24	38.10	62.34	0.51	0.81	1.32	0.01	0.01	0.02
Forest and Woodlands	14.64	17.52	32.16	2.11	2.52	4.63	0.08	0.11	0.19	0.00	0.00	0.00
Vegetation Management	4.28	1.74	6.02	0.61	0.25	0.86	0.01	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	6.47	10.17	16.64	0.67	1.05	1.72	0.16	0.22	0.37	0.00	0.00	0.01
Off-Highway Vehicles	18.67	14.67	33.34	17.18	13.50	30.67	55.44	43.56	99.00	4.79	3.76	8.55
Project Year 2024 Total	**2,400.85**	**1,200.80**	**3,601.65**	**307.66**	**167.12**	**474.78**	**794.28**	**438.66**	**1,232.93**	**68.03**	**38.54**	**106.57**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	271.63	150.96	422.60	737.99	375.07	1,113.07	82.74	42.33	125.07
Oil Development/Production	123.30	67.88	191.17	15.47	8.52	23.99	1.55	0.85	2.40
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	5.32	1.95	7.27	0.79	0.29	1.08	0.08	0.03	0.11
Resource Roads	0.08	0.08	0.16	0.11	0.12	0.23	0.01	0.01	0.02
ROW and Corridors	1.28	1.42	2.70	0.21	0.23	0.44	0.02	0.02	0.04
Livestock Grazing	0.08	0.13	0.21	0.02	0.03	0.04	0.00	0.00	0.00
Renewable Energy	0.41	0.32	0.73	0.07	0.05	0.12	0.01	0.01	0.01
Fire Management	5.88	9.23	15.11	2.45	3.84	6.29	0.24	0.38	0.63
Forest and Woodlands	0.55	0.64	1.19	0.11	0.12	0.23	0.01	0.01	0.02
Vegetation Management	0.04	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.32	0.47	0.79	0.04	0.05	0.09	0.00	0.00	0.01
Off-Highway Vehicles	2,190.14	1,720.83	3,910.97	622.72	489.28	1,112.01	0.00	0.00	0.00
Project Year 2024 Total	**2,611.55**	**1,958.32**	**4,569.87**	**1,381.92**	**878.28**	**2,260.20**	**84.86**	**43.72**	**128.58**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-35. Cumulative Annual Emissions Associated with Alternative C - Project Year 2015

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	49.99	21.85	71.84	17.13	8.03	25.15	212.99	98.34	311.33	0.85	0.38	1.23
Oil Development/Production	197.90	80.35	278.25	42.89	15.12	58.01	833.39	255.31	1,088.71	109.97	33.68	143.65
Locatables	1,512.45	531.40	2,043.85	165.27	58.07	223.34	58.03	20.39	78.42	0.19	0.07	0.26
Salable Minerals	405.65	118.86	524.51	41.65	12.21	53.86	9.41	2.76	12.17	0.08	0.02	0.10
Resource Roads	125.97	62.68	188.65	13.52	6.73	20.25	0.50	0.25	0.75	0.04	0.02	0.05
ROW and Corridors	8.01	4.67	12.68	0.95	0.55	1.49	1.97	1.15	3.13	0.03	0.02	0.05
Livestock Grazing	14.14	9.97	24.11	1.98	1.44	3.42	0.21	0.08	0.29	0.01	0.00	0.01
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.19	0.15	0.34	0.01	0.01	0.01
Fire Management	667.54	262.25	929.79	96.97	38.10	135.07	2.06	0.81	2.87	0.03	0.01	0.04
Forest and Woodlands	39.27	17.51	56.78	5.65	2.51	8.16	0.22	0.11	0.33	0.00	0.00	0.00
Vegetation Management	1.11	1.74	2.85	0.16	0.25	0.41	0.00	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	25.88	10.17	36.05	2.67	1.05	3.71	0.51	0.22	0.72	0.01	0.00	0.01
Off-Highway Vehicles	26.58	20.88	47.46	24.45	19.21	43.66	37.52	29.48	67.00	4.29	3.37	7.65
Project Year 2015 Total	**3,133.85**	**1,188.97**	**4,322.82**	**421.92**	**170.04**	**591.96**	**1,157.02**	**409.05**	**1,566.07**	**115.49**	**37.58**	**153.07**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	266.14	133.58	399.71	1,115.26	493.86	1,609.12	121.94	54.38	176.31
Oil Development/Production	213.83	66.53	280.36	26.84	8.28	35.12	2.68	0.83	3.51
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	6.65	1.95	8.60	0.99	0.29	1.28	0.10	0.03	0.13
Resource Roads	0.16	0.08	0.24	0.23	0.12	0.35	0.02	0.01	0.03
ROW and Corridors	2.08	1.42	3.49	0.38	0.23	0.61	0.04	0.02	0.06
Livestock Grazing	0.32	0.13	0.45	0.07	0.03	0.09	0.01	0.00	0.01
Renewable Energy	0.30	0.23	0.53	0.06	0.05	0.11	0.01	0.00	0.01
Fire Management	23.50	9.23	32.74	9.78	3.84	13.62	0.98	0.38	1.36
Forest and Woodlands	1.20	0.32	1.52	0.22	0.07	0.29	0.02	0.01	0.03
Vegetation Management	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	1.17	0.47	1.64	0.10	0.05	0.15	0.01	0.00	0.01
Off-Highway Vehicles	2,420.75	1,902.02	4,322.77	908.02	713.44	1,621.46	0.00	0.00	0.00
Project Year 2015 Total	**2,948.63**	**2,120.38**	**5,069.01**	**2,063.88**	**1,220.93**	**3,284.82**	**126.00**	**55.74**	**181.74**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-36. Cumulative Annual Emissions Associated with Alternative C - Project Year 2024

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	57.68	24.18	81.86	20.26	8.98	29.24	250.01	109.57	359.58	0.99	0.43	1.42
Oil Development/Production	238.31	96.05	334.36	47.48	16.95	64.43	842.57	259.58	1,102.15	111.09	34.20	145.29
Locatables	1,512.45	531.40	2,043.85	165.27	58.07	223.34	58.03	20.39	78.42	0.19	0.07	0.26
Salable Minerals	405.65	118.86	524.51	41.65	12.21	53.86	9.41	2.76	12.17	0.08	0.02	0.10
Resource Roads	125.97	62.68	188.65	13.52	6.73	20.25	0.50	0.25	0.75	0.04	0.02	0.05
ROW and Corridors	8.01	4.67	12.68	0.95	0.55	1.49	1.97	1.15	3.13	0.03	0.02	0.05
Livestock Grazing	14.14	9.97	24.11	1.98	1.44	3.42	0.21	0.08	0.29	0.01	0.00	0.01
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.24	0.18	0.42	0.01	0.01	0.01
Fire Management	667.54	262.25	929.79	96.97	38.10	135.07	2.06	0.81	2.87	0.03	0.01	0.04
Forest and Woodlands	39.28	17.52	56.80	5.66	2.52	8.18	0.22	0.11	0.33	0.00	0.00	0.00
Vegetation Management	1.11	1.74	2.85	0.16	0.25	0.41	0.00	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	25.88	10.17	36.05	2.67	1.05	3.71	0.51	0.22	0.72	0.00	0.00	0.01
Off-Highway Vehicles	18.67	14.67	33.34	17.18	13.50	30.67	55.44	43.56	99.00	4.79	3.76	8.55
Project Year 2024 Total	**3,174.05**	**1,200.80**	**4,374.86**	**422.39**	**167.12**	**589.50**	**1,221.17**	**438.66**	**1,659.83**	**117.25**	**38.54**	**155.79**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	323.53	150.96	474.49	899.27	375.07	1,274.34	100.57	42.33	142.89
Oil Development/Production	217.09	67.88	284.97	27.36	8.52	35.88	2.74	0.85	3.59
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	6.65	1.95	8.60	0.99	0.29	1.28	0.10	0.03	0.13
Resource Roads	0.16	0.08	0.24	0.23	0.12	0.35	0.02	0.01	0.03
ROW and Corridors	2.08	1.42	3.49	0.38	0.23	0.61	0.04	0.02	0.06
Livestock Grazing	0.32	0.13	0.45	0.07	0.03	0.09	0.01	0.00	0.01
Renewable Energy	0.41	0.32	0.73	0.07	0.05	0.12	0.01	0.01	0.01
Fire Management	23.50	9.23	32.74	9.78	3.84	13.62	0.98	0.38	1.36
Forest and Woodlands	1.46	0.64	2.10	0.26	0.12	0.38	0.03	0.01	0.04
Vegetation Management	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	1.17	0.47	1.64	0.10	0.05	0.15	0.01	0.00	0.01
Off-Highway Vehicles	2,190.14	1,720.83	3,910.97	622.72	489.28	1,112.01	0.00	0.00	0.00
Project Year 2024 Total	**2,779.05**	**1,958.32**	**4,737.37**	**1,563.17**	**878.28**	**2,441.45**	**104.68**	**43.72**	**148.40**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-37. Cumulative Annual Emissions Associated with Alternative D - Project Year 2015

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	49.98	21.85	71.83	17.12	8.03	25.15	212.91	98.34	311.25	0.85	0.38	1.23
Oil Development/Production	182.94	80.35	263.29	38.52	15.12	53.64	729.55	255.31	984.86	96.26	33.68	129.94
Locatables	1,420.69	531.40	1,952.10	155.17	58.07	213.24	54.40	20.39	74.79	0.19	0.07	0.26
Salable Minerals	304.63	118.86	423.49	31.30	12.21	43.51	7.06	2.76	9.82	0.06	0.02	0.08
Resource Roads	79.78	62.68	142.46	8.56	6.73	15.29	0.32	0.25	0.56	0.02	0.02	0.04
ROW and Corridors	5.94	4.67	10.61	0.69	0.55	1.24	1.47	1.15	2.62	0.03	0.02	0.05
Livestock Grazing	12.68	9.97	22.65	1.83	1.44	3.27	0.11	0.08	0.19	0.00	0.00	0.01
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.43	0.19	0.15	0.34	0.01	0.01	0.01
Fire Management	333.77	262.25	596.02	48.49	38.10	86.58	1.03	0.81	1.84	0.01	0.01	0.02
Forest and Woodlands	22.29	17.51	39.80	3.19	2.51	5.70	0.14	0.11	0.24	0.00	0.00	0.00
Vegetation Management	2.21	1.74	3.95	0.31	0.25	0.56	0.01	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	12.94	10.17	23.11	1.33	1.05	2.38	0.27	0.22	0.49	0.01	0.00	0.01
Off-Highway Vehicles	26.58	20.88	47.46	24.45	19.21	43.66	37.52	29.48	67.00	4.29	3.37	7.65
Project Year 2015 Total	**2,513.79**	**1,188.97**	**3,702.76**	**339.61**	**170.04**	**509.65**	**1,044.97**	**409.05**	**1,454.03**	**101.72**	**37.58**	**139.30**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	265.91	133.58	399.48	925.50	493.86	1,419.36	102.10	54.38	156.48
Oil Development/Production	187.69	66.53	254.22	23.53	8.28	31.81	2.35	0.83	3.18
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	4.99	1.95	6.94	0.74	0.29	1.03	0.07	0.03	0.10
Resource Roads	0.10	0.08	0.18	0.15	0.12	0.26	0.01	0.01	0.03
ROW and Corridors	1.80	1.42	3.22	0.29	0.23	0.52	0.03	0.02	0.05
Livestock Grazing	0.16	0.13	0.29	0.03	0.03	0.06	0.00	0.00	0.01
Renewable Energy	0.30	0.23	0.53	0.06	0.05	0.11	0.01	0.00	0.01
Fire Management	11.75	9.23	20.99	4.89	3.84	8.73	0.49	0.38	0.87
Forest and Woodlands	0.41	0.32	0.74	0.09	0.07	0.16	0.01	0.01	0.02
Vegetation Management	0.02	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.60	0.47	1.08	0.06	0.05	0.11	0.01	0.00	0.01
Off-Highway Vehicles	2,420.75	1,902.02	4,322.77	908.02	713.44	1,621.46	0.00	0.00	0.00
Project Year 2015 Total	**2,907.00**	**2,120.38**	**5,027.38**	**1,865.30**	**1,220.93**	**3,086.23**	**105.28**	**55.74**	**161.02**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

Table 4-38. Cumulative Annual Emissions Associated with Alternative D - Project Year 2024

	Emissions (Tons per Year)											
Project Scenario/Resource	**PM_{10}**			**$PM_{2.5}$**			**NO_x**			**SO_x**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	57.67	24.18	81.85	20.25	8.98	29.23	249.94	109.57	359.51	0.99	0.43	1.42
Oil Development/Production	219.93	96.05	315.98	42.75	16.95	59.70	738.29	259.58	997.87	97.33	34.20	131.53
Locatables	1,420.69	531.40	1,952.10	155.17	58.07	213.24	54.40	20.39	74.79	0.19	0.07	0.26
Salable Minerals	304.63	118.86	423.49	31.30	12.21	43.51	7.06	2.76	9.82	0.06	0.02	0.08
Resource Roads	79.78	62.68	142.46	8.56	6.73	15.29	0.32	0.25	0.56	0.02	0.02	0.04
ROW and Corridors	5.94	4.67	10.61	0.69	0.55	1.24	1.47	1.15	2.62	0.03	0.02	0.05
Livestock Grazing	12.68	9.97	22.65	1.83	1.44	3.27	0.11	0.08	0.19	0.00	0.00	0.01
Renewable Energy	59.36	46.64	106.00	8.64	6.79	15.44	0.28	0.18	0.47	0.01	0.01	0.02
Fire Management	333.77	262.25	596.02	48.49	38.10	86.58	1.03	0.81	1.84	0.01	0.01	0.02
Forest and Woodlands	22.30	17.52	39.82	3.21	2.52	5.72	0.14	0.11	0.25	0.00	0.00	0.00
Vegetation Management	2.21	1.74	3.95	0.31	0.25	0.56	0.01	0.00	0.01	0.00	0.00	0.00
Vegetation – Invasive Species	12.94	10.17	23.11	1.33	1.05	2.38	0.27	0.22	0.49	0.00	0.00	0.01
Off-Highway Vehicles	18.67	14.67	33.34	17.18	13.50	30.67	55.44	43.56	99.00	4.79	3.76	8.55
Project Year 2024 Total	**2,550.59**	**1,200.80**	**3,751.39**	**339.72**	**167.12**	**506.83**	**1,108.76**	**438.66**	**1,547.42**	**103.44**	**38.54**	**141.97**

Project Scenario/Resource	**CO**			**VOC**			**HAP**		
	BLM	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**	**BLM**	**Non-BLM**	**Cumulative**
Natural Gas Development/Production	323.31	150.96	474.27	759.80	375.07	1,134.87	85.99	42.33	128.31
Oil Development/Production	190.71	67.88	258.59	24.02	8.52	32.54	2.40	0.85	3.25
Locatables	12.52	4.40	16.92	1.94	0.68	2.62	0.19	0.07	0.26
Salable Minerals	4.99	1.95	6.94	0.74	0.29	1.03	0.07	0.03	0.10
Resource Roads	0.10	0.08	0.18	0.15	0.12	0.26	0.01	0.01	0.03
ROW and Corridors	1.80	1.42	3.22	0.29	0.23	0.52	0.03	0.02	0.05
Livestock Grazing	0.16	0.13	0.29	0.03	0.03	0.06	0.00	0.00	0.01
Renewable Energy	0.43	0.32	0.75	0.09	0.05	0.15	0.01	0.01	0.01
Fire Management	11.75	9.23	20.99	4.89	3.84	8.73	0.49	0.38	0.87
Forest and Woodlands	0.81	0.64	1.45	0.16	0.12	0.28	0.02	0.01	0.03
Vegetation Management	0.02	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Vegetation – Invasive Species	0.60	0.47	1.08	0.06	0.05	0.11	0.01	0.00	0.01
Off-Highway Vehicles	2,190.14	1,720.83	3,910.97	622.72	489.28	1,112.01	0.00	0.00	0.00
Project Year 2024 Total	**2,737.35**	**1,958.32**	**4,695.67**	**1,414.89**	**878.28**	**2,293.18**	**89.23**	**43.72**	**132.94**

BLM	Bureau of Land Management	PM_{10}	particulate matter less than 10 microns in diameter
CO	carbon monoxide	$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
HAP	hazardous air pollutant	SO_x	sulfur oxides
NO_x	nitrogen oxides	VOC	volatile organic compound

4.10 Irreversible and Irretrievable Commitment of Resources

Section 1502.16 of CEQ regulations requires that the discussion of environmental consequences include a description of "…any irreversible or irretrievable commitment of resources which would be involved in the proposal should it be implemented." An irreversible commitment of resources refers to decisions affecting the use of resources (generally nonrenewable resources) that limit the ability for future generations to use that resource. For example, extraction and processing of sand and gravel as part of an aggregate mining operation is considered an irreversible commitment of salable minerals. This action is irreversible because once the minerals are extracted and processed, they cannot be renewed in the ground within a reasonable timeframe, and are therefore unavailable for use by future generations. An irretrievable commitment of resources refers to decisions resulting in the loss of production or use of a resource. For example, a decision not to treat juniper encroachment into adjacent sagebrush habitat results in the irretrievable loss of forage production from the grassland community. This action is not irreversible, because a treatment applied to the encroaching juniper could restore the forage production of the sagebrush habitat.

Though the decision to select one of the four alternatives described in this Draft RMP and EIS does not authorize implementation level (activity- or project-specific) activities, all of the alternatives contain decisions on the management of resources that may lead to future irreversible and irretrievable commitments of those resources. Decisions made in the selected plan serve to guide future actions and subsequent site-specific decisions. Following the signing of the RODs for the RMP revision, implementation plans will be developed and implemented by the BLM. Implementation decisions require appropriate project specific planning and NEPA analysis, and constitute BLM's final approval authorizing on-the-ground activities to proceed. Assuming the BLM selects one of the action alternatives, and that subsequent implementation decisions authorize activity- or project-specific plans, irreversible and irretrievable commitment of resources would occur. For most resources, the RMP will provide objectives for management and guidance for future implementation level decisions to minimize the potential for irreversible and irretrievable commitments of resources.

Table 4-39 identifies the irreversible and irretrievable impacts to resources and resource uses that may occur as a result of implementing one of the four alternatives. No irreversible or irretrievable commitment of resources are anticipated for air quality, visual resources, lands and realty, renewable energy, ROW and corridors, CTTM, recreation, special designations, and socioeconomic resources.

Table 4-39. Irreversible and Irretrievable Resource Commitments

Resource	Irreversible	Irretrievable	Explanation
Physical, Biological, and Heritage Resources			
Soil	X		Surface-disturbing activities, nonmechanized activities, and natural processes cause soil erosion in the Planning Area. Soil formation can take thousands of years and, therefore, eroded soil and, to a lesser extent, lost productivity are considered unrecoverable.
Water		X	Depletion of surface water from in the Planning Area watersheds may result in an irretrievable commitment of water that would otherwise have contributed to the Missouri River System. Produced water from oil and gas wells in the Planning Area may be an irretrievable commitment of groundwater, depending on its use, once it reaches the surface. Increases in sediment, salinity, and nonpoint source pollution that result from surface-disturbing activities could result in degradation of water quality and an irretrievable loss of water utility.
Vegetation		X	Allowing surface-disturbing activities consistent with the BLM's multiple-use mandate would result in both long- and short-term alteration and removal of vegetation cover that would not be available to meet other resource objectives. In some instances, disturbance may result in a long-term shift in plant communities.
Fish and Wildlife		X	Activities that result in the alteration of habitat by shifting vegetation communities can displace wildlife, reduce carrying capacity, and change wildlife communities, resulting in lower species diversity and, thus, irretrievable commitment of these resources. Potential impacts to wildlife include obstacles and barriers affecting traditional ranges and migration corridors of big game and resulting in concentrated herbivory that may cause damage to habitat.
Cultural and Paleontological Resources	X		Any surface-disturbing activities may damage, destroy, or otherwise affect cultural and paleontological resources. Once disturbed, these resources cannot be replaced and the potential for collecting or preserving meaningful data is compromised.
Resource Uses			
Locatable Minerals	X		Allowing the removal of locatable minerals from the ground is considered an irreversible commitment of these resources.
Leasable Minerals	X		Allowing the removal of oil and gas or any solid leasable mineral from the ground is considered an irreversible commitment of these resources.
Mineral Materials	X		Allowing the removal of mineral materials from the ground is considered an irreversible commitment of these resources.
Forest Products		X	Any decision to prohibit silviculture treatments is an irretrievable commitment of the wood fiber produced.
Livestock Grazing		X	Forage consumed by livestock is unavailable for wildlife. Conversely, any decision to prohibit livestock grazing is also an irretrievable commitment of the forage produced.

4.11 Unavoidable Adverse Impacts

Assuming that the BLM selects one of the action alternatives and that subsequent implementation decisions authorize activity- or project-specific plans, unavoidable adverse impacts would occur. Unavoidable adverse impacts are the residual impacts of implementing management actions or allowable uses after BMPs and mitigation measures are applied. As discussed in Section 4.10 *Irreversible and Irretrievable Commitments of Resources*, the decision to select one of the four alternatives described in this RMP and EIS would not result in unavoidable adverse impacts because the decision does not authorize on-the-ground activities.; however, subsequent implementation level decisions may. This section describes the potential unavoidable adverse impacts that may occur from these implementation level decisions.

Surface-disturbing activities (e.g., construction of well pads and roads, pits and reservoirs, pipelines and powerlines, mining, and vegetation treatments), OHV use, fire and fuels management, some recreational activities, concentrated herbivory, and operation and maintenance of existing facilities and infrastructure in the Planning Area would cause fugitive dust, exhaust emissions, and smoke, thereby adversely affecting air quality through the release of HAPs, VOCs, CO, SO_2, NO, and PM_{10} into the atmosphere. In addition, these activities would release CO_2, CH_4 (primarily from livestock grazing), and other GHGs into the atmosphere.

Surface-disturbing activities, motorized vehicle use and recreation, fire and fuels management, herbivory, and the operation and maintenance of existing facilities and infrastructure in the Planning Area would contribute to soil erosion and soil compaction, sediment loading of waterbodies, and the potential spread of invasive species. Invasive species will continue to spread via the wind, in water courses, and by attaching to livestock, wildlife, humans, and vehicles. The continued presence of invasive species in the Planning Area is considered an unavoidable impact.

Surface-disturbing activities and the development of mineral, energy, and other facilities in the Planning Area are expected to cause the unavoidable degradation, loss, and fragmentation of habitats, and therefore will unavoidably affect wildlife that depends on these habitats. Motorized vehicle use and recreational activities, fire and fuels management, concentrated herbivory, and the operation and maintenance of existing facilities and infrastructure in the Planning Area would contribute to the unavoidable degradation, loss, and fragmentation of habitats.

Protection of some resource values (e.g., wildlife, special status species, cultural, cave and karst, and paleontological resources) would adversely affect the development of minerals and renewable energy. Conversely, the development of minerals and renewable energy would adversely affect the distribution of some wildlife, special status species, and vegetative communities.

Surface-disturbing activities and development for resource uses would change the landscape, scenic quality, and setting in the Planning Area. Surface-disturbing activities, motorized vehicle use, theft and vandalism, and natural processes (e.g., erosion) would adversely affect cultural and paleontological resources in the Planning Area.

CHAPTER 5 – PUBLIC INVOLVEMENT AND LIST OF PREPARERS

Public involvement, consultation, and coordination initiated prior to and occurred throughout preparation of the Bighorn Basin Resource Management Plan (RMP) revision and associated Draft Environmental Impact Statement (EIS). The Bureau of Land Management (BLM) incorporated public involvement, consultation, and coordination through public meetings, informal meetings, individual contacts, news releases, newsletters, workshops, a planning website, and the *Federal Register*. This chapter describes the public involvement process, as well as other key consultation and coordination activities undertaken to prepare the EIS in support of the RMP revision. It also contains the List of Preparers in Table 5-2.

The BLM decision-making process is conducted in accordance with the requirements of the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations implementing NEPA, and the United States Department of the Interior (DOI) and BLM policies and procedures implementing NEPA. NEPA and the associated regulatory and policy framework require that all federal agencies involve the interested public and potentially affected parties in their decision-making, consider reasonable alternatives to proposed actions, and prepare environmental documents that disclose the potential impacts of proposed actions and alternatives.

A Notice of Intent (NOI) published in the *Federal Register* on October 17, 2008, formally announced the BLM's intent to revise the existing plans and prepare the associated EIS. The NOI initiated the scoping process and invited participation of affected and interested agencies, organizations, and members of the public in determining the scope and issues to be addressed by alternatives and analyzed in the EIS. The BLM solicited additional public involvement, including cooperating agency meetings and workshops, to help identify issues to be addressed in developing a full range of land management alternatives. Table 5-1 lists public involvement, coordination, and consultation events.

5.1 Public Involvement

In accordance with CEQ scoping guidance, the BLM provided opportunities for public involvement as an integral part of revising the RMP and preparing the EIS. CEQ scoping guidance defines scoping as the "process by which lead agencies solicit input from the public and interested agencies on the nature and extent of issues and impacts to be addressed and the methods by which they will be evaluated" (CEQ 1981). The scoping report, which summarizes public participation during scoping and issues identified during the scoping process, is available on the Bighorn Basin RMP website at http://www.blm.gov/wy/st/en/programs/Planning/rmps/bighorn.html.

The intent of the scoping process is to provide an opportunity for the public, tribes, other government agencies, and interest groups to learn about the project and provide input on the planning issues, impacts, and potential alternatives that will be addressed in the EIS, and the extent to which those issues will be analyzed. In general, public involvement during scoping assists the agency through the following:

- Broadening the information base for decision-making
- Informing the public about the EIS and proposed RMP and the potential impacts associated with various management decisions
- Ensuring public needs and viewpoints are brought to the attention of the agency
- Determining the scope and the significant issues to be analyzed in depth in the EIS

Table 5-1. Public Involvement, Coordination, and Consultation Events

Date	Location	Event
November 5, 2008	Thermopolis, Wyoming	Public Scoping Meeting
November 6, 2008	Worland, Wyoming	Public Scoping Meeting
November 7, 2008	Greybull, Wyoming	Public Scoping Meeting
November 12, 2008	Cody, Wyoming	Public Scoping Meeting
November 13, 2008	Powell, Wyoming	Public Scoping Meeting
November 14, 2008	Lovell, Wyoming	Public Scoping Meeting
January 12, 2009	Greybull, Wyoming	Travel Management and Recreation Assessment Meeting
January 13, 2009	Lovell, Wyoming	Travel Management and Recreation Assessment Meeting
January 14, 2009	Cody, Wyoming	Travel Management and Recreation Assessment Meeting
January 15, 2009	Worland, Wyoming	Travel Management and Recreation Assessment Meeting
January 16, 2009	Thermopolis, Wyoming	Travel Management and Recreation Assessment Meeting
March 25 – 27, 2009	Cody, Wyoming	Cooperating Agency Workshop/Development of the Goals and Objectives
April 29 – May 1, 2009	Worland, Wyoming	Cooperating Agency Workshop/Development of the Range of Alternatives
May 27 – 29, 2009	Worland, Wyoming	Cooperating Agency Workshop/Development of the Range of Alternatives
June 24 – 26, 2009	Cody, Wyoming	Cooperating Agency Workshop/Development of the Range of Alternatives
July 29 – 31, 2009	Thermopolis, Wyoming	Cooperating Agency Workshop/Development of the Range of Alternatives
October 28, 2009	Cody, Wyoming	Open House
February 17 – 19, 2010	Cody, Wyoming	Cooperating Agency Workshop/Development of the Preferred Alternative
April 5, 2010	Worland, Wyoming	Open House

5.1.1 Scoping Period

Publication of the NOI on October 17, 2008 announced the BLM's intention to revise existing plans and prepare a Draft EIS. The scoping period provides an opportunity for the public to identify potential planning issues and concerns associated with the RMP and EIS. Information obtained by the BLM during scoping is combined with issues identified by the agencies to form the scope of the EIS.

5.1.2 Public Notification of Scoping

News Release

The BLM issued a news release to local media on October 14, 2008, describing the upcoming NOI and listing the time, date, and location of the public scoping meetings. Copies of the news release went out to numerous radio stations and newspapers within and outside the Planning Area. The news release was also posted on the Bighorn Basin RMP Revision Project website.

Postcard

Another means of outreach prior to the public scoping meetings included a postcard mailing announcing the scoping meetings. The BLM mailed the postcards to cooperating agencies, individuals and organizations on the project mailing list (see the following section, Scoping Meetings), as well as P.O. Box holders in the Planning Area. The BLM mailed 2,679 postcards on October 21, 2008, and more than 2,500 were successfully delivered.

Additional Sources of Public Information about the Scoping Process

In addition to news releases and other notifications from the BLM regarding the scoping process, some members of the public received notification from other sources. More than 15 articles and news bulletins regarding some aspect of the RMP process were published in newspapers, both within and outside the Planning Area. Many of the articles listed the dates for the scoping period and the dates, times, and locations of public scoping meetings. Most of the articles provided some background regarding the purpose of the RMP revision and information about the process. The County Commissioners for the counties within the Planning Area, all of whom are cooperating agencies, also contacted county residents and interest groups. The County Commissioners from Park County used an automated phone system, e-mails, and radio to contact thousands of county residents and invite them to attend the public meetings and participate in the scoping process. Big Horn, Washakie, and Hot Springs Counties performed similar outreach efforts including contacting county residents, posting flyers, and taking part in radio outreach.

Website

On October 17, 2008, the Bighorn Basin RMP Revision Project website came online. The website provides background information on the project, a description of the scoping process and meeting locations, instructions on how to submit comments, a map of the Planning Area, and copies of public information documents such as the NOI and the Preparation Plan. The website is one of the methods used to communicate project news and updates to the public. The website can be accessed at: http://www.blm.gov/wy/st/en/programs/Planning/rmps/bighorn.html.

5.1.3 Scoping Meetings

During the weeks of November 3, 2008 and November 10, 2008, the BLM hosted scoping meetings in six locations across the Planning Area. Table 5-1 lists the scoping meeting locations and dates. The six public scoping meetings provided the public with an opportunity to learn and ask questions about the project and the planning process and to submit their issues and concerns to the BLM. The BLM chose an open house format over a more formal public meeting format to encourage broader participation, to allow attendees to learn about the project at their own pace, and to enable attendees to ask questions of BLM representatives in an informal one-on-one setting.

In addition to members of the BLM Interdisciplinary Team, a total of 381 people attended the scoping meetings. The BLM provided four handouts and presented four display boards at each scoping meeting. BLM resource specialists also brought maps, photographs, pamphlets, and other visual aids to the meetings for use when speaking with the public.

The BLM encouraged meeting attendees to comment by submitting written comment forms (either at the meetings or via mail) or by sending an e-mail. Comment sheets were available to attendees at all meetings, as was a computer station where the public could type and submit their comments. Attendees to the November 14 public meeting received a notification of the extension of the scoping period until November 24, 2008. At the November 12 through November 14 meetings, attendees also received a survey from the County Commissioners.

5.1.4 Open Houses/Public Meetings

After the public scoping period closed, the BLM held two open house meetings in Cody and in Worland, Wyoming. Similar to the public scoping meetings, resource specialists and other representatives of the BLM were on hand to personally address questions and provide information to meeting participants. The BLM also hosted five public workshops to obtain information and input on travel management and recreational activities at locations throughout the Basin that were attended by 203 participants.

Mailing List

The BLM compiled a list of 158 individuals, agencies, and organizations that participated in past BLM projects or requested to be on the general mailing list. The BLM mailed the initial scoping postcard to each individual on this list. In addition to those on the general mailing list, the BLM purchased a mailing list covering the entire Bighorn Basin (over 16,000 addresses) and mailed postcards to P.O. Box addresses included in this basin-wide list (2,485 addresses). Visitors to the scoping meetings were asked to sign in and provide their mailing address so that they could also be added to the mailing list. Other additions to the mailing list include those individuals who have submitted requests to be added to the list. Duplicate entries, changes of address, and return-to-sender mailings were deleted from the official project mailing list as identified. Through this process, the general mailing list was revised to approximately 500 entries. Requests to be added to or to remain on the official mailing list will continue to be accepted throughout the planning process.

Newsletters

Periodic newsletters have been and are being developed and distributed to keep the public informed of the Bighorn Basin RMP Revision Project. The January 2009 newsletter summarized the public scoping period and invited the public to the recreation and travel management workshops.

Website

The Bighorn Basin RMP Revision Project website can be found at: http://www.blm.gov/wy/st/en/programs/Planning/rmps/bighorn.html. The site serves as a virtual repository for documents related to the development of the RMP, including announcements, newsletters, and documents. The documents are available in PDF format to ensure they are accessible to the widest range of interested parties. The website provides the public an opportunity to submit their comments for consideration as part of the planning process and to be added to the project mailing list.

Field Trips

Six field trips were held during the summer of 2010 to various locations within the Planning Area to provide on-site discussion of RMP topics and to describe opportunities for effective public comment in advance of the 90-day public comment period.

In addition, Field Managers and RMP project leader were available to discuss RMP issues at the invitation of external individuals and groups. Multiple outside groups requested information from BLM managers and staff during 2010.

5.2 Consultation and Coordination

This section documents the consultation and coordination efforts undertaken by the BLM throughout the process of revising the RMP and developing the EIS. Title II, Section 202 of the Federal Land Policy and Management Act (FLPMA) directs the BLM to coordinate planning efforts with Native American Tribes, other federal departments, and agencies of the state and local governments as part of its land use planning process. The BLM is directed to integrate NEPA requirements with other environmental review and consultation requirements to reduce paperwork and delays (40 Code of Federal Regulations 1500.4-5). The BLM accomplished coordination with other agencies and consistency with other plans through ongoing communications, meetings, and collaborative efforts with the BLM Interdisciplinary Team, which includes BLM specialists, and federal, state, and local agencies.

5.2.1 Cooperating Agencies

The BLM invited local, state, federal, and tribal representatives to participate as cooperating agencies on the Bighorn Basin RMP Revision Project and EIS. The BLM invited the following entities to participate because they have jurisdiction by law or because they could offer special expertise:

Counties

- Big Horn County Commission
- Hot Springs County Commission
- Park County Commission
- Washakie County Commission

Conservation Districts

- Cody Conservation District
- Hot Springs Conservation District
- Powell-Clarks Fork Conservation District
- Meeteetse Conservation District
- Shoshone Conservation District
- South Big Horn Conservation District
- Washakie County Conservation District

Wyoming State Agencies

- Office of the Governor
- Department of Agriculture
- Department of Environmental Quality
- Game and Fish Department
- Office of Lands and Investments
- Oil and Gas Conservation Commission
- State Engineer’s Office
- State Geological Survey
- State Historic Preservation Office

Federal Agencies

- U.S. Environmental Protection Agency (EPA), Region 8
- U.S. Forest Service – Shoshone National Forest/Wapati Ranger District
- U.S. Forest Service – Bighorn Ranger District

Tribes

- Northern Cheyenne Tribe Tribal Historic Preservation Office
- Crow
- Rosebud Sioux

The BLM formally invited the cooperating agencies to participate in developing the alternatives and RMP and EIS, and to provide data and other information relative to their agency responsibilities, goals, mandates, and expertise. Cooperating agencies provided input during the initial scoping process. The BLM held general meetings with cooperators to discuss procedures and processes. The BLM hosted teleconferences to obtain cooperator input on the Analysis of the Management Situation in February 2009. The BLM and cooperating agencies held several workshops to develop goals and objectives, a range of alternatives, and the Preferred Alternative between March 2009 and February 2010. Cooperating agencies met with the Field Managers to relay concerns and propose options for the Preferred Alternative between October 2009 and February 2010. The BLM and cooperating agencies have routinely met to be orientated to process and procedures and to resolve process related issues. Though not in effect during meetings and consultation with cooperating agencies and the general public leading up the Draft RMP and Draft EIS, the BLM will apply the guidance provided in Instruction Memorandum No. WY 2010-033 (BLM 2010d) in future public involvement activities for this revision project, including those with cooperating agencies.

Cooperating agencies were provided an opportunity to submit position statements for publication in the Draft RMP and Draft EIS. The intent of these position statements was to allow the cooperating agencies to express their agreement or disagreement on substantive elements of the alternatives or impacts and whether or not these disagreements were adequately resolved in the Agency Preferred Alternative. No position statements were provided opposing the Agency Preferred Alternative, and only the Wyoming Department of Agriculture and the Washakie County Conservation District provided positions statements for publication in this Draft RMP and Draft EIS (Appendix E).

5.2.2 Section 7 Consultation

The Worland and Cody Field Offices contacted the U.S. Fish and Wildlife Service (USFWS) regarding Section 7 of the Endangered Species Act and the Bighorn Basin Resource Management Plan revision. The BLM sent a scoping letter to the USFWS requesting comments concerning Section 7 consultation and the Bighorn Basin RMP revision project. On November 13 of 2008 the USFWS provided comments on (1) threatened and endangered species, (2) migratory birds, and (3) wetlands and riparian areas. Within these comments was also provided a list of threatened and endangered species likely to occur on BLM-administered land in the Worland and Cody Field Offices, for evaluating BLM Section 7 responsibilities. The USFWS was also provided opportunities to comment on chapters 2 and 4 of the draft RMP and Draft EIS, and in November and December of 2009 comments were received on both chapters. Consultation letters concerning the Bighorn Basin RMP revision project are located in Appendix E. The Worland and Cody Field Office will continue consultation with the USFWS regarding the RMP revision through completion of the final biological assessment and final EIS and proposed RMP.

5.2.3 Native American Interests

Consultation with Native American tribes is part of the NEPA process and a requirement of FLPMA. The BLM invited Native American tribes to be cooperating agencies as part of the RMP revision and three tribes attended cooperator meetings. On October 10, 2008, the BLM sent letters to the following 11 tribes inviting them to be part of the planning process through consultation and public scoping meetings:

- Blackfeet
- Cheyenne River Sioux
- Crow
- Eastern Shoshone
- Nez Perce
- Northern Arapahoe
- Northern Cheyenne
- Oglala Sioux
- Rosebud Sioux
- Salish & Kootenai
- Shoshone Bannock

The consultation letters invited Native American tribes to comment on interests or concerns related to management in the Planning Area and asked tribes to identify any places of traditional religious or cultural importance within the Planning Area. An example consultation letter between the Native American tribes and the BLM is included in Appendix E.

Following the scoping process, the BLM sent a letter to each of the above tribes requesting specific information to help identify areas of special concern for the tribes and presenting the opportunity for meetings or field trips with tribal representatives. BLM representatives followed these letters with telephone calls to each tribe. In letters and during the follow-up calls, the BLM stressed its desire for the tribes to review and comment on this Draft RMP and Draft EIS. On December 17, 2008 the BLM met with tribal representatives in Rapid City, South Dakota to discuss the RMP revision. Additional inquiries were made of interested tribes who might desire face to face opportunities to discuss RMP issues. In January 2010, Field Managers and staff met with the Northern Cheyenne Tribal Historic Preservation Officer to discuss the Tribe's interest in RMP topics. Government-to-government consultation with the tribes will continue throughout the RMP process.

5.3 Distribution List

The BLM distributed the Draft RMP and Draft EIS to the following entities for their review and comment:

TRIBAL GOVERNMENTS

- Blackfeet
- Cheyenne River Sioux
- Crow
- Eastern Shoshone
- Nez Perce
- Northern Arapaho
- Northern Cheyenne
- Oglala Sioux
- Rosebud Sioux
- Salish & Kootenai
- Shoshone-Bannock

LOCAL GOVERNMENTS (COUNTIES, CITIES, TOWNS)

Big Horn County, Wyoming

- Big Horn County Commission
- South Big Horn Conservation District
- Town of Basin
- Town of Greybull
- Town of Manderson
- Town of Lovell

Park County, Wyoming

- Park County Commission
- Cody Conservation District
- Meeteetse Conservation District
- Powell-Clarks Fork Conservation District
- City of Cody
- City of Powell
- Town of Meeteetse

Washakie County, Wyoming

- Washakie County Commission
- Washakie County Conservation District
- City of Worland
- Town of Ten Sleep

Hot Springs County, Wyoming

- Hot Springs County Commission
- Hot Springs Conservation District
- Town of Thermopolis

STATE OF WYOMING

- Senator Henry H.R. 'Hank' Coe
- Senator Gerald Geis
- Senator R. Ray Peterson
- Representative Chas P. "Pat" Childers
- Representative Colin M. Simpson
- Representative Elaine Harvey
- Representative Dave Bonner, Jr.
- Representative Debbie Hammons
- Representative Lorraine Quarberg

WYOMING STATE AGENCIES

- Office of the Governor, Environmental Policy Division
- Business Council
- Department of Environmental Quality
    - Air Quality Division
    - Land Quality Division
    - Water Quality Division
- Department of Agriculture
- Department of State Parks and Cultural Resources
    - State Museum
- Department of Transportation
- State Planning Office
- Game and Fish Department
- State Geologic Survey
- Office of State Lands and Investments
- State Engineer's Office
- State Historic Preservation Office
- Department of Administration and Information
- Department of Employment, Research, and Planning Division

WYOMING STATE BOARDS/COMMISSIONS

- Air Quality Advisory Board
- Board of Wildlife Commissioners
- Natural Gas Pipeline Authority
- Agriculture Board

- Environmental Quality Council
- Farm Bureau Federation
- Land Quality Advisory Board
- Livestock Board
- Mining Council
- Oil and Gas Conservation Commission
- Recreation Commission
- State Board of Outfitters and Professional Guides
- State Grazing Board
- Trails Council

WEED AND PEST CONTROL DISTRICTS

- Big Horn County Weed and Pest Control District
- Hot Springs County Weed and Pest Control District
- Park County Weed and Pest Control District
- Washakie County Weed and Pest Control District

ASSOCIATIONS/COUNCILS

- Coalbed Methane Coordination Coalition
- Mormon Trails Association
- Oregon-California Trails Association
- Petroleum Association of Wyoming
- Powder River Basin Resource Council
- Washakie Development Association
- Wildlife Habitat Council
- Wyoming Association of Municipalities
- Wyoming Association of Conservation Districts
- Wyoming County Commissioners Association
- Wyoming Mining Association
- Wyoming Natural Diversity Database
- Wyoming Outdoor Council
- Wyoming Sportsman's Association
- Wyoming Stock Growers Association
- Wyoming Wilderness Association
- Wyoming Woolgrowers Association
- Western Energy Alliance

CLUBS/ALLIANCES/SOCIETIES/GROUPS

- Audubon Society
- Audubon Wyoming
- Back Country Horsemen of America

- Biodiversity Conservation Alliance
- Foundation for North American Wild Sheep
- Greater Yellowstone Coalition
- Guardians of the Range
- Izaak Walton League
- Land and Water Fund of the Rockies
- Meeteetse Economic Development Alliance
- Murie Audubon Society
- National Wildlife Federation
- North American Pronghorn Foundation
- Outdoor Women of Wyoming
- Public Lands Advocacy Rocky Mountain Elk Foundation
- Sierra Club
- The Conservation Fund
- The Land and Water Fund of the Rockies
- The Land Trust Alliance
- The Nature Conservancy
- The Wilderness Society
- The Wildlife Society
- Trout Unlimited
- Western Land Exchange Project
- Western Watersheds Project
- Wyoming Fly Casters Association
- Wyoming Livestock Roundup
- Wyoming Motorcycle Trails Association
- Wyoming Nature Conservancy
- Wyoming Wildlife Federation
- Wyoming Wildlife Trust Fund

CONGRESSIONAL DELEGATION

- U.S. Senator Michael Enzi
- U.S. Senator John Barrasso
- U.S. Representative Cynthia Lummis

U.S. DEPARTMENT OF THE INTERIOR

- Bureau of Indian Affairs
- U.S. Bureau of Reclamation
- Minerals Management Service
- National Park Service
    - Bighorn Canyon National Recreation Area
    - Yellowstone National Park

- Office of Environmental Policy and Compliance
- Natural Resources Library
- Office of Surface Mining
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
    - Washington, D.C.
    - Cheyenne, Wyoming
- Bureau of Land Management
    - Washington, D.C.
    - Wyoming State Office, Cheyenne
    - Wyoming Field Offices: Buffalo, Casper, Kemmerer, Lander, Newcastle, Pinedale, Rawlins, and Rock Springs

OTHER FEDERAL AGENCIES

- U.S. Environmental Protection Agency
- U.S. Department of Agriculture Forest Service
    - Big Horn National Forest
    - Shoshone National Forest
- U.S. Department of Agriculture Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- Department of Energy Western Area Power Administration
- Federal Highway Administration
- Federal Energy Regulatory Commission
- U.S. Government Printing Office
- Oceanic and Atmospheric Administration's National Weather Service

LIBRARIES

- Library of Congress
- University of Wyoming Library
- Park County Library
- Big Horn County Public Library
- Washakie County Library
- Hot Springs County Library
- Central Wyoming College Library
- Northwest College, Wyoming Library

EDUCATIONAL INSTITUTIONS

- University of Wyoming
- Western Wyoming Community College
- Wyoming Community College Commission
- Central Wyoming College
- Northwest College

MEDIA

Newspapers

- Northern Wyoming Daily News, Worland, Wyoming
- The Independent Record, Thermopolis, Wyoming
- Greybull Standard Tribune, Greybull, Wyoming
- Basin Republican Rustler, Basin, Wyoming
- The Cody Enterprise, Cody, Wyoming
- Powell Tribune, Powell, Wyoming
- Lovell Chronicle, Lovell, Wyoming
- Billings Gazette, Billings, Montana
- Wyoming Livestock Roundup, Casper, Wyoming
- Associated Press, Billings, Montana
- Casper Star Tribune, Casper, Wyoming
- Riverton Ranger, Riverton, Wyoming

Radio

- Big Horn Radio Network: KODI/KZMQ/KTAG/KKLX/KWOR, Cody AM and FM
- KPOW/KLZY, Powell AM and FM
- KTHE, Thermopolis AM
- KWOR/KKLX, Worland AM and FM
- KVOW/KTAK, Riverton AM and FM
- Wyoming Public Radio

5.4 List of Preparers

Table 5-2. List of Preparers

Name	Education (degree, year, school)	Title	Project Role	Years of Experience
Bureau of Land Management				
Caleb Hiner	B.S. Geosciences, 2001, Idaho State University	Planning & Environmental Coordinator	Project Manager/Inspector and Team Leader	9
Andrew Tkach	B.A. English,1978, Indiana University; Administrative Law Certificate, 1982, United States Naval Justice School	Planning & Environmental Coordinator	Worland Technical Coordinator	31
Ann Perkins	B.A. Anthropology, 1988, University of Montana	Planning & Environmental Coordinator	Cody Technical Coordinator	16
Christopher Carlton	MPA	Planning & Environmental Coordinator	State Office Lead	11
Mike Stewart	B.S. Agriculture and Range Management, 1981, University of California at Chico	Field Manager	Cody Field Office Manager	27
Karla Bird	B.S. Range and Wildlands Science, 1979, University of California, Davis	Field Manager	Worland Field Office Manager	32
Eddie Bateson	B.S. Range Resources, 1979, University of Idaho Moscow, Idaho	District Manager	Wind River/Bighorn Basin District Office	33
Roy Allen	B.S. Chemistry M.S. and PhD Economics	Economist	Social Conditions/Economic Conditions/Environmental Justice	33
Sarah Beckwith	B.A. Environmental Studies and Geography, 1993, University of California, Santa Barbara	Public Affairs Specialist	Public Affairs	13
Michael Bies	B.S. History and Sociology/Anthropology, 1977, University of South Dakota. Graduate Level Historical Archeology, 1977-1982, University of Idaho	Archeologist	Cultural including National Historic Trails, Paleontology	37

Table 5-2. List of Preparers (Continued)

Name	Education (degree, year, school)	Title	Project Role	Years of Experience
Shirley Bye-Jech	B.S. Resource Recreation Management -Outdoor Recreation Planning	Outdoor Recreation Planner	Visual Resource Management, OHV, Travel Management, Recreation and Special Designations	31
JoDee Cole	B.A. Anthropology, 1978, Southern Illinois University	Resource Information Specialist	GIS Data Management	33
Kierson Crume	B.A. Anthropology, 1995, University of New Mexico	Archaeologist	Cultural including National Historic Trails	16
Jared Dalebout	B.A. Geology, 2003, Weber State University	Hydrologist	Water, Riparian/Wetlands	4
Holly Elliott	B.S. Environmental Science & Natural Resource Management w/emphasis in Environmental Law/Policy, 2001, University of Nevada, Reno	Natural Resource Specialist – Minerals & Lands	Surface Compliance	13
Duane Feick	B.S. Watershed Management & Fisheries, 1976, North Dakota State	Realty Specialist	Lands & Realty, including Transportation/Access and ROWs, Renewable Energy Utility/Communication Corridors	33
Jim Gates	B.S. Forest Resources, 1996, University of Idaho	Forester	Forestry	17
Monica Goepferd	BS Mining Engineering, 2002, Montana Tech	Supervisory Civil Engineer	Transportation, Facilities, Maintenance	7
Destin Harrell	B.A. Biology, 2000, Western State College	Wildlife Biologist	Wildlife, Special Status Species	10
Patricia (Tricia) Hatle	B.S. Range Science, 1991, University of Wyoming	Rangeland Management Specialist	Wild Horses	21
Cam Henrichsen	B.S. Range Science, 1990, South Dakota State University	Range Management Specialist	Wild Horses	20
Karen Hepp	B.S. Range/Wildlife, 1983, University of Nebraska	Rangeland Management Specialist	Rangeland Vegetation, Special Status Species	25
Melissa Hovey	BS Civil Engineering, 1984, University of Maine MS Environmental Engineering, 1988, Colorado State University	Air Quality Specialist	Air Quality	14

Table 5-2. List of Preparers (Continued)

Name	Education (degree, year, school)	Title	Project Role	Years of Experience
Gretchen Hurley	B.S. Natural Science & Mathematics, 1981, University of Wyoming	Geologist	Paleontology, Minerals	29
Gerald (Jerry) Jech	B.S. Range Management/Wildlife, 1981, Washington State University	Natural Resource Specialist (CYFO) (Riparian/Wetland/Aquatic Resources, Soil, & Water)	Riparian/Wetland/Aquatic Resources, Vegetation (Riparian/Wetland, Grasslands/Shrublands), Water, & Fish	28
Steve Kiracofe	B.S. Agronomy, Soil Science, University of Maryland Masters Certificate – Hazardous Waste Management, Wayne State University	Natural Resource Specialist	Soil, Water, Riparian/Wetlands, Vegetation (Grasslands, Shrublands, Special Status Plants),Health & Safety – Abandoned Mine Lands, Hazardous Materials, Geologic Hazards	32
Bryan McKenzie	B.S. Agro-Ecology, 2001, University of Wyoming	Rangeland Management Specialist & BLM Wyoming State Cave Coordinator	Cave and Karst	11
Rance Neighbors	B.S. Forestry, 2002, Auburn University	Natural Resource Specialist	Invasive Species	7
Jack Mononi	B.S., 1975, California State University, Chico	Rangeland Management Specialist	Livestock Grazing, Fire Ecology	31
Paul Rau	B.S. Geography, 2000, University of Wyoming	Outdoor Recreation Planner	Visual Resource Management, OHV, Travel Management, Recreation and Special Designations	9
Dennis Saville	B.S. Wildlife Management 1988, University of Wyoming 2 years graduate study in Wildlife and Recreation, 1982-1983, University of Wyoming	Wildlife Biologist	Wildlife, Special Status Species	17
David Seward	B.S. Range Management, 1995, University of Wyoming	Natural Resource Specialist	Surface Compliance	16
Carol Sheaff	BLM-Lands Academy, 2003. Northwest Community College, Various courses. University of Nebraska, Kearney, Education	Realty Specialist	Lands & Realty, including Transportation/Access and ROWs, Renewable Energy Utility/Communication Corridors	27

Table 5-2. List of Preparers (Continued)

Name	Education (degree, year, school)	Title	Project Role	Years of Experience
Pete Sokolosky	B.S. Geology, 1975, University of South Alabama	Geologist	Minerals	28
Tim Stephens	B.A. Greenville College, 1983 M.S. Environmental Biology, 1985, Emporia State University Teachers Certificate, 1988, Lawrence University, Appleton Wisconsin	Biologist	Fish & Wildlife, Special Status Species	21
Mike Tietmeyer	B.S. Range Science, 1983, Texas A&M University	Rangeland Management Specialist	Livestock Grazing	27
Eve Warren	B.S. Wildlife Management, 1991, Utah State University M.S. Conservation Biology, 1993, Utah State University PhD, Range Science, 2001, Texas Tech University	Natural Resource Specialist	Rangeland Vegetation	19
Criss Whalley	B.S. Range Management, 1984, Humboldt State University M.S. Plant Science, 1987, University of Nevada, Reno	Rangeland Management Specialist	Livestock Grazing	24
Chet Wheeless	B.S. Wildlife/Fisheries, 1974, New Mexico State University M.S. Environmental Studies, 1981, University of Montana	Fisheries Biologist	Fish & Wildlife	27
Bill Wilson	B.S. Watershed Science, 1979, Utah State University	GIS Specialist	GIS Data Management	31
Jim Wolf	B.S. Range Ecology, 1983, Colorado State University	Fire Management Specialist	Fire Ecology	26

Table 5-2. List of Preparers (Continued)

Name	Education (degree, year, school)	Title	Project Role	Years of Experience
John Zachariassen	B.S. Biology, 1981, Carleton University M.S. Soils, 1985, University of Nebraska-Lincoln Ph.D., Biogeochemistry/ Atmosphere-Bios Interactions, 1992 Colorado State University	Air Quality Specialist	Air Quality	12
Consultant				
ICF International – Interdisciplinary Team				
Science Applications International Corporation (SAIC) – Interdisciplinary Team				
OTAK – Interdisciplinary Team				

CHAPTER 6 – REFERENCES

Anderson, E.W. and R.J. Scherzinger. 1975. Improving Quality of Winter Forage for Elk by Cattle Grazing. Journal of Range Management 28:120-125.

APHIS (Animal and Plant Health and Inspection Service) and BLM (Bureau of Land Management). 2003. Memorandum of Understanding Document #03-8100-0870-MU, February 27, 2003.

APHIS and BLM. 1995. Master Memorandum of Understanding, March 21, 1995.

APLIC (Avian Power Lines Interaction Committee) and USFWS (U.S. Fish and Wildlife Service). 2005. Avian Protection Plan Guidelines. A Joint Document Prepared By The Edison Electric Institute's Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service. April.

Bailey, R.G. 1995. Description of the Ecoregions of the United States (2nd ed.). Misc. Pub. No. 1391, USDA Forest Service. 108 pp. Plus map: Map scale 1:7,500,000.

Bailey, W.B., R.G. Welling, and E.T. Miller. 2001. Cattle Use of Foothills Rangeland Near Dehydrated Molasses Supplement. Journal of Range Management 54:338-347.

Bartos, D.L. 2001. Landscape Dynamics of Aspen and Conifer Forests. USDA (U.S. Department of Agriculture) Forest Service Proceedings RMRS-P-18.

Bartos, D.L. and R.B. Campbell. 1998. Decline of Aspen in the Interior West – Examples from Utah. Rangelands 20(1):17-24.

Bartuszevige, A.M. and B.A. Endress. 2008. Do Ungulates Facilitate Native and Exotic Plant Spread? Seed Dispersal by Cattle, Elk, and Deer in Northeastern Oregon. Journal of Arid Environments 72:904-913.

BEA (Bureau of Economic Analysis). 2010a. Regional Economic Information System, 1969-2008. Available on Internet: http://www.bea.gov/regional/reis/default.cfm. Accessed June 2010.

BEA. 2010b. Regional Economic Information System: Local Area Personal Income and Employment Methodology. Available on Internet: http://www.bea.gov/regional/pdf/lapi2008/lapi2008.pdf. Accessed June 2010.

Beever, E.A. and J.E. Herrick. 2006. Effects of Feral Horses in Great Basin Landscapes on Soils and Ants: Direct and Indirect Mechanisms. Journal of Arid Environments 66(1):96-112.

Beever, E.A. 2003. Management Implications of the Ecology of Free-Roaming Horses in Semi-Arid Ecosystems of the Western United States. Wildlife Society Bulletin 31(3):887-895.

Belsky, A.J., A. Matzke, and S. Uselman. 1999. Survey of Livestock Influences on Stream and Riparian Ecosystems in the Western United States. Journal of Soil and Water Conservation 54:419-431.

BHBLWG (Big Horn Basin Sage-grouse Local Working Group). 2007. Sage-grouse Conservation Plan for the Big Horn Basin, Wyoming.

Big Horn County. 2005. Big Horn County Mountain Community Wildfire Protection Plan, March 31, 2005.

Big Horn County. 2009. 2009 Big Horn County Land Use Plan. Adopted January 6, 2010. Available on Internet: http://www.bighorncountywy.gov/dep-land-planning-land-use-plan.htm.

Birds of North America Online. 2008. Cornell Lab of Ornithology and the American Ornithologists' Union. Available on Internet: http://bna.birds.cornell.edu/bna/. Accessed November 18, 2008.

BLM. 1976. Environmental Analysis Record, Horse Roundup North Shoshone Area- Two Miles N.E. of Lovell, Wyoming. U.S. Department of the Interior, Bureau of Land Management, Wyoming.

BLM. 1978. The Influence of Livestock Grazing on Non-game Wildlife.

BLM. 1980. Memorandum regarding the North Shoshone Wild Horse Herd, from Range Conservationist Cody Resource Area. July 21, 1980. U.S. Department of the Interior, Bureau of Land Management, Cody Resource Area, Cody, Wyoming.

BLM. 1981. Environmental Analysis, Spring Creek Wild Horse Removal, Washakie Resource Area. WY-010-981. U.S. Department of the Interior, Bureau of Land Management, Wyoming.

BLM. 1983a. Grass Creek Resource Area Reservoir Habitat Management Plan. U.S. Department of the Interior, Bureau of Land Management, Wyoming.

BLM. 1983b. Grass Creek Grazing Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management, Worland District Office, Worland, Wyoming.

BLM. 1984a. Grass Creek Resource Area Stream Habitat Management Plan. U.S. Department of the Interior, Bureau of Land Management, Wyoming.

BLM. 1984b. West Slope Habitat Management Plan. U.S. Department of the Interior, Bureau of Land Management. Worland District Office, Worland, Wyoming.

BLM. 1986a. Absaroka Front Habitat Management Plan. W1-WHA-T10. U.S. Department of the Interior, Bureau of Land Management, Wyoming.

BLM. 1986b. Historic Trails Plans 1986. Oregon/Mormon Pioneer National Historic Trails Management Plan. U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office, Cheyenne, Wyoming.

BLM. 1986c. Manual 8410-1, Visual Resource Inventory. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/nstc/VRM/8410.html.

BLM. 1986d. Manual 8431-1, Visual Resource Contrast Rating. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/nstc/VRM/8431.html.

BLM. 1987. Bighorn River Habitat and Recreation Management Plan. Prepared in cooperation with the Wyoming Game and Fish Department.

BLM. 1988. Washakie Resource Management Plan. U.S. Department of the Interior, Bureau of Land Management, Worland District Office, Worland, Wyoming.

BLM. 1990. Cody Resource Area – Resource Management Plan. U.S. Department of the Interior, Bureau of Land Management, Cody Resource Area, Cody, Wyoming.

BLM. 1992a. Upland Game Bird Habitat Management on the Rise. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 1992b. Raptor Habitat Management. Fish and Wildlife 2000. National Strategy Plan Series. U.S. Department of the Interior, Bureau of Land Management. August.

BLM. 1992c. Nongame Migratory Bird Habitat Conservation Plan. Fish and Wildlife 2000. National Strategy Plan Series. U.S. Department of the Interior, Bureau of Land Management.

BLM. 1993. Mineral Potential Report for the Grass Creek Resource Area Resource Management Plan/Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management. Worland District Office, Worland, Wyoming.

BLM. 1994a. Red Gulch/Alkali National Backcountry Byway Interpretive Master Plan. U.S. Department of the Interior, Bureau of Land Management. Worland, Wyoming. June.

BLM. 1994b. Decision Record and Finding of No Significant Impact for the Washakie Resource Area Reservoir Habitat Management Plan, WY-010-WHA-T23. Environmental Assessment EA-WY-015-EA2-78.

BLM. 1994c. Brown/Howe Dinosaur Area in the Cody Resource Area Big Horn County, Wyoming, Environmental Assessment WY-017-EA3-056. U.S. Department of the Interior, Bureau of Land Management. Cody Resource Area, September 1994.

BLM. 1995a. H-8550-1 Interim Management Policy and Guidelines for Lands Under Wilderness Review. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 1995b. Instruction Memorandum 96-04, Use of Land Exchanges. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 1996. Partners Against Weeds: An Action Plan for Bureau of Land Management. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/weeds/PAW/index.htm.

BLM. 1998a. Grass Creek Resource Management Plan. U.S. Department of the Interior, Bureau of Land Management, Worland District, Worland, Wyoming.

BLM. 1998b. Riparian Area Management, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. Technical Reference 1737-15. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/nstc/library/techref.htm.

BLM. 1999. Riparian Area Management, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas. Technical Reference 1737-16. Revised 2003. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/nstc/library/techref.htm.

BLM. 2000. Instruction Memorandum 2000-182, Mitigating and Remediating Physical Safety Hazards at Abandoned Mine Land Sites. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2001a. BLM Manual 6840, Special Status Species Management. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2001b. National Strategy for Motorized Off-Highway Vehicle Use on Public Lands. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/ohv/OHV_FNL.pdf.

BLM. 2002a. Worland Field Office Review of Potential Wild and Scenic Rivers in the Washakie Resource Management Plan Planning Area. U.S. Department of the Interior, Bureau of Land Management, Worland, Wyoming.

BLM. 2002b. Instruction Memorandum WY-2002-164, Guidance to Address Environmental Justice in Land Use Plans and Related National Environmental Policy Act Documents. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2003a. Cody Field Office Review of Potential Wild and Scenic Rivers in the Cody RMP Planning. U.S. Department of the Interior, Bureau of Land Management, Cody, Wyoming.

BLM. 2003b. Statewide Programmatic Bald Eagle Biological Assessment. U.S. Department of the Interior, Bureau of Land Management, Wyoming State Field Office, Cheyenne, Wyoming.

BLM. 2004a. Fire Management Plan: Wyoming Northern Zone. U.S. Department of the Interior, Bureau of Land Management. Worland, Wyoming. Available on Internet: http://www.blm.gov/wy/st/en/programs/ Fire/planning.html.

BLM. 2004b. National Sage-grouse Habitat Conservation Strategy. 1.4.1 Guidance for the Management of Sagebrush Plant Communities for Sage-Grouse Conservation. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2004c. BLM Manual 8130, Planning for Uses of Cultural Resources. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2004d. BLM Manual 8110, Identifying Cultural Resources. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2004e. BLM Manual 8120, Tribal Consultation Under Cultural Resource Authorities. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2004f. Final Statewide Programmatic Gray Wolf Biological Assessment. Wyoming State Office, Cheyenne, Wyoming.

BLM. 2005a. Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western States. June. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2005b. Land Use Planning Handbook H-1601-1. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2005c. Record of Decision for Implementation of a Wind Energy Development Program and Associated Land Use Plan Amendments. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2005d. Statewide Programmatic Black-tailed Prairie Dog (*Cynomys ludovicianus*) Biological Evaluation. Submitted March 8, 2007. U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office. Cheyenne, Wyoming.

BLM. 2005e. Technical Reference 1734-6 Interpreting Indicators of Rangeland Health. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/nstc/library/pdf/1734-6rev05.pdf.

BLM. 2005f. Final Statewide Programmatic Grizzly Bear (*Ursus arctos*) Biological Assessment. Updated June 29, 2006. U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office. Cheyenne, Wyoming.

BLM. 2005g. Mountain Plover (*Charadrius montanus*) Biological Evaluation. Final Report. September. U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office. Cheyenne, Wyoming.

BLM. 2005h. Final Statewide Programmatic Canada Lynx (*Lynx canadensis*) Biological Assessment. U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office. Cheyenne, Wyoming.

BLM. 2006a. Instruction Memorandum 2006-216, Wind Energy Development Policy, August 24, 2006. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2006b. Instruction Memorandum 2006-073, Weed-Free Seed Use on Lands Administered by the Bureau of Land Management U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2007a. Final Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/wo/st/en/prog/more/veg_eis.html.

BLM. 2007b. Burned Area Emergency Stabilization and Rehabilitation Handbook. H-1742-1. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.52739.File.dat/h1742-1.pdf.

BLM. 2007c. Instruction Memorandum No. 2008-030, Instructions for Implementing the National Vegetation Treatments Final Programmatic Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/20080/im_2008-030.html.

BLM. 2007d. Instruction Memorandum No. 2007-097, Solar Energy Development Policy, April 4, 2007. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2007e. Instruction Memorandum No. 2007-043, A Unified Strategy to Implement BLM's Priorities for Recreation and Visitor Services Workplan. January 9. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2007f. Post-fire Recovery of Wyoming Big Sagebrush Shrub-steppe in Central and Southeast Montana. U.S. Department of the Interior, Bureau of Land Management. Montana State Office. Billings, Montana.

BLM. 2008a. Automated Fluid Management Support System. BLM internal federal oil and gas lease database. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2008b. MS-8380 Cave and Karst Management. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2008c. Analysis of the Management Situation. Bighorn Basin Planning Area. Unpublished internal report. Cody Field Office, Worland Field Office. U.S. Department of the Interior, Bureau of Land Management. Worland, Wyoming.

BLM. 2008d. LR2000 – Land and Mineral Legacy Rehost 2000 System. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/lr2000/.

BLM. 2008e. Wyoming State Office Plan Summary – Mineral Material Disposals – Sales and Free Use Permits. Unpublished annual database and report to the Washington Office. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2008f. Draft 2008 Wyoming Northern Zone Fire Management Plan (Unpublished). U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office. Cheyenne, Wyoming.

BLM. 2008g. Instruction Memorandum No. 2009-043, Wind Energy Development Policy, December 19, 2008. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2008h. Recreation Management Information System. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2009a. Geographic Information System (GIS) Data. U.S. Department of the Interior, Bureau of Land Management, Cody Field Office and Worland Field Office, Wyoming.

BLM. 2009b. Summary of the Analysis of the Management Situation for the Bighorn Basin Planning Area, U.S. Department of the Interior, Bureau of Land Management, Cody Field Office and Worland Field Office. Available on Internet: http://www.blm.gov/wy/st/en/programs/Planning/rmps/bighorn/docs.html.

BLM. 2009c. Solid Mineral Occurrence and Development Potential Report: Bighorn Basin Resource Management Plan Revision Project. U.S. Department of the Interior, Bureau of Land Management, Cody Field Office and Worland Field Office, Wyoming. Available on Internet: http://www.blm.gov/wy/st/en/programs/Planning/rmps/ bighorn/docs.html.

BLM. 2009d. Bighorn Basin Cultural Class I Regional Overview. Cody Field Office, Worland Field Office. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming. September.

BLM. 2009e. Reasonable Foreseeable Development Scenario for Oil and Gas, Bighorn Basin Planning Area, Wyoming. Prepared by Wyoming Reservoir Management Group. May 6, 2009. U.S. Department of the Interior, Bureau of Land Management.

BLM. 2009f. Proposed Oil Shale and Tar Sands Resource Management Plan Amendments to Address Land Use Allocations in Colorado, Utah and Wyoming and Final Programmatic Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2009g. Visual Resource Inventory for the Cody Field Office. U.S. Department of the Interior, Bureau of Land Management, Cody Field Office. Cody, Wyoming.

BLM. 2009h. Scoping Report Bighorn Basin Resource Management Plan Revision Project, March 20, 2009. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2009i. Summary of the Analysis of the Management Situation for the Buffalo Field Office. U.S. Department of the Interior, Bureau of Land Management, Buffalo Field Office. Buffalo, Wyoming. Available on Internet: http://www.blm.gov/wy/st/en/programs/Planning/rmps/buffalo/docs.html.

BLM. 2009j. Reasonable Foreseeable Development Scenario for Geothermal, Bighorn Basin Planning Area, Wyoming. Prepared by Wyoming Reservoir Management Group. March 13, 2009. U.S. Department of the Interior, Bureau of Land Management.

BLM. 2009k. Vegetation Treatment GIS Coverage; National Fire Plan Operations and Reporting System. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2009l. Instruction Memorandum No. WY-2009-022, Wyoming Bureau of Land Management Reclamation Policy. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2009.Par.54664.File.dat/ wy2009-022.pdf.

BLM. 2009m. Riparian Aquatic Information Data System. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2009n. Personal communication between T. Hatle (Range/Wild Horse Specialist) and A. Tkach regarding wild horses remaining in Herd Management Areas following fall 2009 roundup. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2009o. Environmental Assessment WY-020-EA08-86, Finding of No Significant Impact and Decision Record. Location: McCullough Peaks Herd Management Area. October 26. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM. 2009p. Instruction Memorandum No. 2009-138, Confidentiality of Paleontological Locality Information Under the Omnibus Public Lands Act of 2009 (123 Stat. 991), Title VI, Subtitle D, Paleontological Resources Preservation (OPLA-PRP). June 5, 2009. Available on Internet: http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2009/IM_2009-138.html. Accessed July 20, 2009.

BLM. 2009q. Instruction Memorandum No. 2009-113, Casual Collecting of Common Invertebrate and Plant Paleontological Resources under the Paleontological Resources Preservation Act of 2009. April 24, 2009. Available on Internet: http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2009/IM_2009-113.html. Accessed July 20, 2009.

BLM. 2009r. Recreation Planning. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on Internet: http://www.blm.gov/wo/st/en/prog/Recreation/national_recreation/recreation_planning.print.html. Accessed August 2009.

BLM. 2009s. Documentation Forms from BLM Cody and Worland Field Offices Wilderness Characteristics Inventory. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2009t. Draft Addendum to the Cody Field Office Review of Potential Wild And Scenic Rivers in the Cody RMP Planning Area. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office, Wyoming.

BLM. 2009u. Reservoir Management Group, Bighorn Basin Well Count By Alternative. September 29. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2010a. BLM Wyoming Sensitive Species Policy and List. U.S. Department of the Interior, Bureau of Land Management. Wyoming State Office, Cheyenne, Wyoming. March 31, 2010. Available on Internet: http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2010.Par.41285.File.dat/wy2010-027atch2.pdf.

BLM. 2010b. Draft Areas of Critical Environmental Concern Evaluation Report. Bighorn Basin Resource Management Plan Revision Project. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2010c. BLM Air Quality Worksheets. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office and Worland Field Office, Wyoming.

BLM. 2010d. Instruction Memorandum No. WY 2010-033, BLM Wyoming Guidance on Public Information Process and National Environmental Policy Act (NEPA). U.S. Department of the Interior, Bureau of Land Management. Washington, D.C.

BLM, ACHP (Advisory Council on Historic Preservation), and National Conference of State Historic Preservation Officers. 1997. Programmatic Agreement Among the Bureau of Land Management, Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in Which BLM Will Meet its Responsibilities Under the National Historic Preservation Act.

BLM, Land and Resources Project Office. 2008. Rangeland Administration System. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Available on internal intranet: http://web.ras.blm.gov/ras/ras.html.

BLM and DOE (Department of Energy). 2003. Assessing the Potential for Renewable Energy on Public Lands. February. U.S. Department of the Interior, Bureau of Land Management. U.S. Department of Energy, Energy Efficiency and Renewable Energy.

BLM, State of Montana DEQ (Department of Environmental Quality), and MBOGC (Montana Board of Oil and Gas Conservation). 2003. Montana Final Statewide Oil and Gas Environmental Impact Statement (EIS) and Proposed Amendment of the Powder River and Billings Resource Management Plans. Available on Internet: http://www.deq.state.mt.us/coalbedmethane/finaleis.asp.

BLM and USFS (U.S. Forest Service). 2007. BLM and Forest Service Announce 2007 Federal Grazing Fee. BLM-CA-N-07-31. February 2.

BLM and USFS. 2008a. Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States. Available on Internet: http://www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide.html.

BLM and USFS. 2008b. Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States. December.

BLM and USFS. 2009. BLM and Forest Service Announce 2009 Federal Grazing Fee. January 30, 2009.

BLM and USFS. 2010. Forest Service and BLM Announce Grazing Fee. Washington, DC, January 29. Available on Internet: http://www.fs.fed.us/news/2010/releases/01/grazing.shtml. Accessed June 2010.

BLM and Wyoming SHPO (State Historic Preservation Office). 2006. Programmatic Agreement Among the Bureau of Land Management, Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers Regarding the Manner in Which BLM Will Meet its Responsibilities Under the National Historic Preservation Act, State Protocol Between the Wyoming Bureau of Land Management and the Wyoming State Historic Preservation Officer. March 3.

BLS (Bureau of Labor Statistics). 2010a. Local Area Unemployment Statistics and Historical Labor Force. Available on Internet: http://data.bls.gov. Accessed June 2010.

BLS. 2010b. Labor Force Statistics from the Current Population Survey: Series ID LNU04000000, Unemployment Rate. (Not Seasonally Adjusted). Available on Internet: http://data.bls.gov. Accessed June 2010.

Braun, C.E. 2002. A Review of Sage-Grouse Habitat Needs and Sage-Grouse Management Issues for the Revision of the Bureau Of Land Management's Pinedale District Resource Management Plan. Prepared for The Wilderness Society, Wyoming Outdoor Council, and Greater Yellowstone Coalition by Grouse, Inc. Tucson, Arizona.

CCS (Center for Climate Strategies). 2007. Wyoming Greenhouse Gas Inventory and Reference Case Projections 1990-2020.

CEQ (Council on Environmental Quality). 1997a. Council on Environmental Quality Environmental Justice Guidance Under the National Environmental Policy Act. Executive Office of the President of the United States. Washington, D.C.

CEQ. 1997b. Considering Cumulative Effects Under the National Environmental Policy Act. January 1997. Executive Office of the President of the United States. Washington, D.C.

Cerovski, A.O., M. Grenier, B. Oakleaf, L. Van Fleet, and S. Patla. 2004. Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming. Wyoming Game and Fish Department Nongame Program, Lander, Wyoming, 206 pp.

CertainTeed Gypsum. 2008. Annual Report – Gypsum Mining for 2007. Submitted to the Wyoming Department of Environmental Quality. Unpublished Annual Report.

Cody Conservation District. 2007. Long Range Plan 2007-2012. Cody Conservation District.

Coe, P.K., B.K. Johnson, K.M. Steward, and J.G. Kie. 2004. Spatial and Temporal Interactions of Elk, Mule Deer, and Cattle. Transactions of the Sixty-ninth North American Wildlife and Natural Resources Conference, pp. 656-669.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to Manage Sage-Grouse Populations and their Habitats. Wildlife Society Bulletin 28(4):967-985.

Connelly, J.W, S.T. Knick, M.A. Schroeder, and S.J. Stiver. 2004. Conservation Assessment of Greater Sage-Grouse and Sagebrush Habitats - Western Association of Fish and Wildlife Agencies.

Cooperative Riparian Restoration Montana. 2006. Proper Functioning Condition, Montana Training Sessions for 2006. Available on Internet: http://water.montana.edu/pdfs/2006_pfc.pdf.

Crawford, J.A., R.A. Olson, N.E. West, J.C. Mosley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg, and C.S. Boyd. 2004. Ecology and Management of Sage-grouse and Sage-grouse Habitat. Range Management 57:2-19.

CREG (Consensus Revenue Estimating Group). 2009. Wyoming State Government Revenue Forecast, Fiscal Year 2010 – Fiscal Year 2014. Cheyenne, Wyoming. October. Available on Internet: http://eadiv.state.wy.us/creg/GreenCREG_Oct09.pdf. Accessed June 2010.

Davies, K.W., T.J. Svejcar, and J.D. Bates. 2009. Interaction of Historical and Nonhistorical Disturbances Maintains Native Plant Communities. Ecological Applications 19:1536-1545.

Derner, J.D., W.K. Lauenroth, P. Stapp, and D.J. Augustine. 2009. Livestock as Ecosystem Engineers for Grassland Bird Habitat in the Western Great Plains of North America. Journal of Rangeland Ecology & Management 62:111-118.

Diamond, J.M., C.A. Call, and N. Devoe. 2009. Effects of Targeted Cattle Grazing on Fire Behavior of Cheatgrass-dominated Rangeland in the Northern Great Basin. International Journal of Wildland Fire 18:944-950.

DiTomaso, J.M. 2000. Invasive Weeds in Rangelands: Species, Impacts, and Management. Weed Science 48:255-265.

DOE. 2009. Press Release: President Obama Announces Over $467 Million in Recovery Act Funding for Geothermal and Solar Energy Projects. May 27. Available on Internet: http://www.energy.gov/news2009/7427.htm.

DOE (U.S. Department of Energy) and BLM. 2008a. Record of Decision for Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States (DOE/EIS-0386).

DOE and BLM. 2008b. Programmatic Environmental Impact Statement, Designation of Energy Corridors on Federal Land in the 11 Western States (DOE/EIS-0386).

DOI (U.S. Department of the Interior). 2006a. Scientific Inventory of Onshore Federal Lands Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to their Development - Energy Policy and Conservation Act of 2000. U.S. Department of the Interior. Washington, D.C.

DOI. 2006b. Interagency Burned Area Emergency Response Guidebook. U.S. Department of the Interior. Washington, D.C. Available on Internet: http://www.fws.gov/fire/ifcc/esr/Policy/es_handbook_2-7-06.pdf. Accessed October 15, 2009.

DOI. 2007. Departmental Manual 517, Integrated Pest Management. U.S. Department of the Interior. Washington, D.C. Available on Internet: www.fws.gov/contaminants/Documents/DOIIPMpolicyFINAL.pdf.

DOI. 2010. Climate Science Centers. U.S. Department of the Interior. Washington, D.C. Available on Internet: http://www.doi.gov/whatwedo/climate/strategy/CSC-Map.cfm. Accessed July 27, 2010.

DOI and The Nature Conservancy. 2008. Interagency Fire Regime Condition Class Guidebook. BIA (Bureau of Indian Affairs), BLM, NPS (National Park Service), USFWS, and The Nature Conservancy. Available on Internet: www.frcc.gov. Accessed August 5, 2010.

Downs, G.R. 1952. Summary of Mesozoic Stratigraphy, Bighorn Basin, Wyoming: Wyoming Geological Association Guidebook, 7th Annual Field Conference.

DRA (Dean Runyan Associates). 2007. The Economic Impact of Travel on Wyoming: 1997-2006 Detailed State and County Estimates. Prepared for the State Office of Travel and Tourism, Wyoming Business Council. Portland, Oregon. September.

DRA. 2008. The Economic Impact of Travel on Wyoming: 1997-2007 Detailed State and County Estimates. Prepared for the State Office of Travel and Tourism, Wyoming Business Council. Portland, Oregon. September.

DRA. 2010. The Economic Impact of Travel on Wyoming: 1997-2009p (preliminary) Detailed State and County Estimates. Prepared for the State Office of Travel and Tourism, Wyoming Business Council. Portland, Oregon. May. Available on Internet: http://www.wyomingbusiness.org/pdf/tourism/18_may_10_WYSt09pRptFinal.pdf. Accessed June 14, 2010.

Eagle Bear, Russell. 2009. Personal Communication between Russell Eagle Bear and Chris Willson (Science Applications International Corporation) regarding Sioux cultural resources. Rosebud Sioux Tribe, Rosebud, South Dakota.

EIA (Energy Information Administration). 2009. Annual Energy Outlook 2009 with Projections to 2030. Report No. DOE/EIA-0383(2009). Released March 2009. U.S. Department of Energy, Energy Information Administration. Available on Internet: http://www.eia.doe.gov/oiaf/aeo/electricity.html.

EPA (U.S. Environmental Protection Agency). 1989. Region 8 Wyoming State Implementation Plans. U.S. Environmental Protection Agency.

EPA. 1993. Region 8 Wyoming State Implementation Plans. U.S. Environmental Protection Agency.

EPA. 1999. Region 8 Wyoming State Implementation Plans. U.S. Environmental Protection Agency.

EPA. 2003. MOBILE6 Vehicle Emission Modeling Software. U.S. Environmental Protection Agency. Available on Internet: http://www.epa.gov/otaq/m6.htm.

EPA. 2007. Region 8 Wyoming State Implementation Plans. U.S. Environmental Protection Agency.

EPA. 2008. NONROAD2008a Model. U.S. Environmental Protection Agency. Available on Internet: http://www.epa.gov/otaq/nonrdmdl.htm.

EPA. 2009a. Air Data: Access to Air Pollution Data. U.S. Environmental Protection Agency. Available on Internet: http://www.epa.gov/air/data/index.html.

EPA. 2009b. Nitrous Oxide Sources and Emissions. U.S. Environmental Protection Agency. Available on Internet: http://www.epa.gov/nitrousoxide/sources.html.

EPA. 2010. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008. Public Review Draft. U.S. Environmental Protection Agency.

Erickson, W.P., G.D. Johnson, and D.P. Young Jr. 2005. A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. U.S. Forest Service General Technical Report PSW-GTR-191.

Eustes, A.W. 2003. Directional Drilling Seminar: Course Notes from Bureau of Land Management Directional Drilling Seminar held in Casper, Wyoming. March 18-19.

Faaborg, J., M. Brittingham, T. Donovan, and J. Blake. 1995. Habitat Fragmentation in the Temperate Zone. Pages 357-380. In: T.E. Martin and D. Finch, editors. Ecology and Management of Neotropical Migratory Birds: A Synthesis and Review of Critical Issues. Oxford University Press, New York, New York.

Fanshawe, John R. 1971. Structural Evolution of Big Horn Basin: Wyoming Geological Association Guidebook, 23rd Annual Field Conference.

Fenner, J.N., and M. Kornfeld. 2006. 2006 Rockshelter Testing in Lone Tree Canyon (PRCALD) and Spring Creek Canyon (BMAD). Technical Report No. 43. George C. Frison Institute of Archaeology and Anthropology. University of Wyoming.

Fertig, W. 2000a. *Astragalus gilviflorus* var. *purpureus* - Dubois Milkvetch. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Astragalus_gilviflorus_purpureus.pdf. Accessed July 23, 2009.

Fertig, W. 2000b. *Cymopterus evertii* - Evert's Waterparsnip. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Cymopterus_evertii.pdf. Accessed July 23, 2009.

Fertig, W. 2000c. *Cymopterus williamsii* - Williams' Spring Parsley. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Cymopterus_williamsii.pdf. Accessed July 23, 2009.

Fertig, W. 2000d. *Descurainia Torulosa* - Wyoming Tansymustard. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Descurainia_torulosa.pdf. Accessed May 11, 2010.

Fertig, W. 2001. *Astragalus jejunus* var. *articulatus* - Hyattville Milkvetch. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/ Astragalus_jejunus_articulatus.pdf. Accessed July 23, 2009.

Fertig, W. and S. Mills. 2000. *Shoshonea pulvinata* - Shoshonea. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/ Shoshonea_pulvinata.pdf. Accessed July 23, 2009.

Fertig, W. and L. Welp. 2001. Status of Hyattville Milkvetch (*Astragalus jejunus* var. *articulatus*) in Wyoming. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/WYNDDReports/U01FER05WYUS.pdf. Accessed October 21, 2009.

Fisher, Conrad. 2009. Personal Communication between Conrad Fisher and Chris Willson (Science Applications International Corporation) regarding Northern Cheyenne cultural resources. Northern Cheyenne Tribe, Lame Deer, Montana.

Flora of North America Association. 1993a. *Pinus flexilis* - Limber Pine. Flora of North America. Available on Internet: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500936. Accessed May 11, 2010.

Flora of North America. 1993b. *Pinus albicaulis* - Whitebark Pine. Flora of North America Association. Available on Internet: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500921. Accessed May 11, 2010.

Freddy, D.J., W.M. Brenough, and M.C. Fowler. 1986. Responses of Mule Deer to Disturbances by Persons Afoot and Snowmobiles. Wildlife Society Bulletin 14:63-68.

Frisina, M.R. 1992. Elk Habitat Use within a Rest-rotation Grazing System. Rangelands 14:93-96.

Furniss, M.J., S. Flanagan, and B. McFadin. 2000. Hydrologically-Connected Roads: An Indicator of the Influence of Roads on Chronic Sedimentation, Surface Water Hydrology, and Exposure to Toxic Chemicals. In: Stream Notes. Stream Systems Technology Center, USDA Forest Service, Rocky Mountain Research Station. Fort Collins, Colorado. Available on Internet: www.stream.fs.fed.us/news/streamnt/jul00/jul00_2.htm#anchortop.

Georgia Pacific Gypsum, LLC. 2008. Annual Report – Gypsum Mining for 2007. Submitted to the Wyoming Department of Environmental Quality. Unpublished Annual Report.

Glass, Gary B. 1981. Coal Deposits of Wyoming: Wyoming Geological Association Guidebook, 32nd Annual Field Conference.

Glass, Gary B., K. Westervelt, and C.G. Oviatt. 1975. Coal Mining in the Bighorn Coal Basin of Wyoming: Wyoming Geological Association Guidebook, 27th Annual Field Conference.

Global Change Research Program. 2009. United States Global Change Research Program. Global Climate Change Impacts in the U.S. June 16. Available on Internet: http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/regional-climate-change-impacts/great-plains.

Gruver, J.C. and D.A. Keinath. 2006. Townsend's Big-eared Bat (*Corynorhinus townsendii*): A Technical Conservation Assessment. USDA Forest Service, Rocky Mountain Region. Available on Internet: http://www.fs.fed.us/r2/projects/scp/assessments/townsendsbigearedbat.pdf.

Hall, F.C. and L.D. Bryant. 1995. Herbaceous Stubble Height as a Warning of Impending Cattle Grazing Damage to Riparian Areas. USDA Forest Service, Pacific Northwest Research Station. General Technical Report PNW-GTR-362. September.

Handley, J. and B. Heidel. 2008. *Rorippa calycina*. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Rorippa_calycina.pdf. Accessed July 23, 2009.

Harrell, D., and L. Marks. 2009. Habitat Selection and Changes in the White-tailed and Black-tailed Prairie Dog Population within the Northern Bighorn Basin, Wyoming. Technical Note 431. U.S. Department of the Interior, Bureau of Land Management. Cody Field Office, Wyoming. BLM/WY/ ST-09/031+1110. 16 pp.

Harris, Larry D. 1984. The Fragmented Forest: Island Biogeography Theory and the Preservation of Biotic Diversity. Chicago, Illinois: University of Chicago Press.

Headwaters Economics. 2007a. A Socioeconomic Profile: Park County, Wyoming. Produced by the Economic Profile System. Available on Internet: http://www.headwaterseconomics.org/eps/.

Headwaters Economics. 2007b. A Socioeconomic Profile: Big Horn County, Wyoming. Produced by the Economic Profile System. Available on Internet: http://www.headwaterseconomics.org/eps/.

Headwaters Economics. 2007c. A Socioeconomic Profile: Hot Springs County, Wyoming. Produced by the Economic Profile System. Available on Internet: http://www.headwaterseconomics.org/eps/.

Headwaters Economics. 2007d. A Socioeconomic Profile: Washakie County, Wyoming. Produced by the Economic Profile System. Available on Internet: http://www.headwaterseconomics.org/eps/.

Heart Mountain Wyoming Foundation. 2009. Heart Mountain - A Story Worth Remembering. Available on Internet: http://www.heartmountain.us/history.htm. Accessed August 5, 2009.

Heidel, B. 2007. *Spiranthes diluvialis* - Ute Ladies'-tresses. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/ SpeciesAbstracts/Spiranthes_diluvialis.pdf. Accessed July 23, 2009.

Holechek, J.L. 1988. An Approach for Setting the Stock Rate. Rangelands 10(1):10-13.

Holechek, J.L., T.T. Baker, J.C. Boren, and D. Galt. 2006. Grazing Impacts on Rangeland Vegetation: What We Have Learned: Livestock Grazing at Light-to-moderate Intensities Can Have Positive Impacts on Rangeland Vegetation in Arid-to-Semiarid Areas. Rangelands 28(1):7-13.

Holloran, M.J., R.C. Kaiser, and W.A. Hubert. 2010. Yearling Greater Sage-Grouse Response to Energy Development in Wyoming. Journal of Wildlife Management 74(1):65-72.

Hot Springs Conservation District. 2006. Hot Springs Conservation District Long Range Plan 2006-2010. Hot Springs Conservation District.

Hot Springs County. 2002. Land Use Plan. 11/18/2002 Revision, Combining the Hot Springs County Land Use Plan and Development Permit System. Available on Internet: http://www.hscounty.com/Upload/File/20080811_538_land_use_plan_1.doc. Accessed August 2009.

Hot Springs County. 2005. Hot Springs County Natural Resources Plan for State and Federal Lands: An Addendum to the Revised Hot Springs County Land Use Plan of 2002. Available on Internet: http://www.hscounty.com/Upload/File/20080811_780_Hot_Springs_county_LUP_1-5-05.doc. Accessed August 2009.

Hurley, G. 2008. Potential Fossil Yield Table.

IHS Energy Group. 2009. Rocky Mountain United States Well Data: Network License for PI/Dwights PLUS Version 1.7.

IMPROVE (Interagency Monitoring of Protected Visual Environments) Data. 2009. Available on Internet: http://vista.cira.colostate.edu/improve.

Interagency Wild & Scenic Rivers Coordinating Council. 2008. Agency-By-Agency Mileage/Management Chart. Available on Internet: http://www.rivers.gov/publications.html.

IPCC (Intergovernmental Panel on Climate Change). 2007a. Climate Change 2007: The Physical Basis (Summary for Policymakers). Cambridge University Press. Cambridge, England and New York, New York. Available on Internet: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf.

IPCC. 2007b. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K., and Reisinger, A. (Eds.). Geneva, Switzerland. 104 pp.

Johnson, M.D and C.M. Horn. 2008. Effects of Rotational Grazing on Rodents and Raptors in Coastal Grassland. Western North American Naturalist 68(4):444-452.

Jones, A. 2000. Effects of Cattle Grazing on North American Arid Ecosystems: A Quantitative Review. Western North American Naturalist 60(2):155-164.

Kay, C.E. 1995. Browsing by Native Ungulates: Effects on Shrub and Seed Production in the Greater Yellowstone Ecosystem. In: Proceedings: Wildland Shrub and Arid Land Restoration Symposium; 1993 October 19-21; Las Vegas, Nevada. General Technical Report INT-GTR-315.

Keeley, J.E. 2006. Fire Management Impacts on Invasive Plants in the Western United States. Conservation Biology 20(2):375-384.

Keinath, D.A. 2004. Fringed Myotis (*Myotis thysanodes*): A Technical Conservation Assessment. USDA Forest Service, Rocky Mountain Region. Available on Internet: http://www.fs.fed.us/r2/projects/scp/assessments/fringedmyotis.pdf.

Kennedy, G. 2008. Personal e-mail communication between G. Kennedy, Bureau of Economic Analysis, and R. Fetter, Science Applications International Corporation, regarding BEA data. October 24 and November 17.

Keyser, J.D. and M.A. Klassen. 2001. Plains Indian Rock Art. University of Washington Press. Seattle.

Keystone Center. 1991. Final Consensus Report of the Keystone Policy Dialogue on Biological Diversity on Federal Lands. Colorado. April.

Knick, S.T., D.S. Dobkin, J.T. Rotenberry, M.A. Schroeder, W.M. Vander Haegen, and C. Van Ripper III. 2003. Teetering on the Edge or Too Late? Conservation and Research Issues for Avifauna of Sagebrush Habitats. The Condor 105:611-634.

Langner, L.L. and C.H. Flather. 1994. Biological Diversity: Status and Trends in the United States. USFS-Rocky Mountain Forest and Range Experiment Station. Colorado. April.

Larson, T.A. 1978. History of Wyoming. University of Nebraska Press, Lincoln.

Lawler, J.J., S.L. Shafer, D. White, P. Kareiva, E.P. Maurer, A.R. Blaustein, and P.J. Bartlein. 2009. Projected Climate-Induced Faunal Change in the Western Hemisphere. Ecology 903(3):588-597.

Leatherman, D.A., I. Aguayo, and T.M. Mehall. 2007. Fact Sheet No. 5.228: Mountain Pine Beetle. Colorado State University Extension. Available on Internet: http://www.ext.colostate.edu/pubs/insect/05528.html. Accessed November 30, 2009.

Luce, R.J. and D. Keinath. 2007. Spotted Bat (*Euderma maculatum*): A Technical Conservation Assessment. USDA Forest Service, Rocky Mountain Region. Available on Internet: http://www.fs.fed.us/r2/projects/scp/assessments/spottedbat.pdf.

Lumley, J.P., B. Basse, and F. Manning. 2010. Letter to Karla Bird and Caleb Hiner. March 16. RE: Recommendation of the Grass Creek Fieldwide Unit in Hot Springs County as a "Special Management Area" for Energy Development.

Manier, D.J., and N.T. Hobbs. 2007. Large Herbivores in Sagebrush Steppe Ecosystems: Livestock and Wild Ungulates Influence Structure and Function. Oecologia 152:739-750.

McCleary, T.P. 2008. Ghosts on the Land. Apsáalooke (Crow Indian) Interpretations of Rock Art. Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Anthropology in the Graduate College of the University of Illinois at Urbana-Champaign. Urbana, Illinois.

McCleary, T.P. 2009. Personal communication between Tim McCleary of the Crow Tribal Historic Preservation Office and Lorraine Gross (Science Applications International Corporation). March 18.

Meeteetse Conservation District. 2010. Land Use Management and Resource Conservation Plan 2010, Meeteetse Conservation District. Available on Internet: http://www.meeteetsecd-wy.gov.

Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of Recreational Trails on Breeding Bird Communities. Ecological Applications 8(1):162-169.

Mills, S. and W. Fertig. 2000a. *Penstemon absarokensis*. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Penstemon_absarokensis.pdf. Accessed July 23, 2009.

Mills, S. and W. Fertig. 2000b. *Physaria saximontana* var. *saximontana*. State Species Abstract. Wyoming Natural Diversity Database. Available on Internet: http://www.uwyo.edu/wynddsupport/docs/Reports/SpeciesAbstracts/Physaria_saximontana_saximontana.pdf. Accessed July 23, 2009.

Muscha, J.M. and A.L. Hild. 2006. Biological Soil Crusts in Grazed and Ungrazed Wyoming Sagebrush Steppe. Journal of Arid Environments 67:195-207.

NADP (National Atmospheric Deposition Program). 2009. NADP/NTN Monitoring. Available on Internet: http://nadp.sws.uiuc.edu/nadpdata.

NASS (National Agricultural Statistics Service). 2009. Range Review, February 2009. Cheyenne, Wyoming. Issue 2009-02. U.S. Department of Agriculture, National Agricultural Statistics Service.

NASS. 2010. Range Review, February 2010. Cheyenne, Wyoming. Issue 2010-02. U.S. Department of Agriculture, National Agricultural Statistics Service.

National Academy of Sciences. 2006. Understanding and Responding to Climate Change: Highlights of National Academies Reports. Division on Earth and Life Studies. National Academy of Sciences. Washington, D.C. Available on Internet: http://dels.nas.edu/dels/rpt_briefs/climate-change-final.pdf.

Neighbors, R. 2010. Personal communication between R. Neighbors, Bureau of Land Management and A. Tkach, Bureau of Land Management, regarding vegetation and fire data. June 9.

NPS (National Park Service). 1993. Indian Lands Judicially Established 1978. Map updated 1993. U.S. Department of the Interior, National Park Service. Available on Internet: http://www.nps.gov/history/nagpra/ONLINEDB/INDEX.HTM. Accessed April 2009.

NPS. 2004. Yellowstone National Park Fire Management Plan. U.S. Department of the Interior. Government Printing Office, Washington, D.C.

NPS. 2006. Mandatory Class I Areas. U.S. Department of the Interior, National Park Service. Available on Internet: www2.nature.nps.gov/air/Maps/images/ClassIAreas.jpg.

NPS. 2008. National Park Service Stats. U.S. Department of the Interior. National Park Service. Available on Internet: http://www.nature.nps.gov/stats/state.cfm?st=wy.

NPS. 2009. Heart Mountain Relocation Center. National Historic Landmark Program. U.S. Department of the Interior, National Park Service. Available on Internet: http://tps.cr.nps.gov/nhl/detail.cfm?ResourceId=1164118837&ResourceType=District. Accessed August 5, 2009.

NRCS (Natural Resources Conservation Service). 1983. Washakie County Soil Survey. U.S. Department of Agriculture., Natural Resources Conservation Service. Available on Internet: http://soils.usda.gov/survey/online_surveys/wyoming/.

OMB (Office of Management and Budget). 1992. Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. Office of Management and Budget. Circular A-94. Revised October 29, 1992. Available on Internet: www.whitehouse.gov/omb/circulars/.

Pannell, F. 2008. Personal communication between Fred Pannell, Wyoming Office of State Lands and Investments, and J. Sidon, Science Applications International Corporation. March.

Park County. 1998. Park County Land Use Plan. September 15. Park County, Wyoming. Available on Internet: http://www.parkcounty.us/planningandzoning/documents/Land%20Use.pdf. Accessed August 2009.

Parker, P.L. and T.F. King. 1998. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin 38. U.S. Department of the Interior, National Park Service.

Paton, P.W. 1994. The Effect of Edge on Avian Nest Success: How Strong is the Evidence? Conservation Biology 8(1):17-26.

Pergams, O.R.W. and P.A. Zaradic. 2006. Is Love of Nature in the U.S. Becoming Love of Electronic Media? 16-year Downtrend in National Park Visits Explained by Watching Movies, Playing Video Games, Internet Use, and Oil Prices. Journal of Environmental Management 80:387-393.

Phillips, G.E. and A.W. Alldredge. 2000. Reproductive Success of Elk Following Disturbance by Humans During Calving Season. Journal of Wildlife Management 64:521-530.

Pierce, W.G. and D.A. Andrews. 1941. Geology and Oil and Coal Resources of the Region South of Cody, Park County, Wyoming. U.S. Geological Survey Bulletin 921-B. U.S. Department of the Interior.

Pilliod, D.S. and E. Wind (editors). 2008. Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern U.S. and Canada. PARC Technical Publication HMG-4. Birmingham, Alabama.

Plafcan, M., E.W. Cassidy, and M.L. Smalley. 1993. USGS Water-Resources Investigations Report 93-4021, Water Resources of Big Horn County, Wyoming.

Powell-Clarks Fork Conservation District. 2004. Bitter Creek Watershed Plan. Powell-Clarks Fork Conservation District.

Powell-Clarks Fork Conservation District. 2006. Long Range Plan 2006-2011. Powell-Clarks Fork Conservation District.

Priday, J. and B. Luce. 1995. Inventory of Bats and Bat Habitat Associated with Caves and Mines in Wyoming Completion Report. Wyoming Game and Fish Department, Bureau of Land Management, U.S. Forest Service-Shoshone National Forest, and U.S. Fish and Wildlife Service. April 14, 1994 - April 14, 1995.

Provencher, L., T.A. Forbis, L. Frid, and G. Medlyn. 2007. Comparing Alternative Management Strategies of Fire, Grazing, and Weed Control Using Spatial Modeling. Ecological Modeling 209:249-263.

Roberts, S.B., and G.S. Rossi. 1999. Chapter SB: A Summary of Coal in the Fort Union Formation (Tertiary), Bighorn Basin, Wyoming and Montana, in U.S. Geological Survey Professional Paper 1625-A. Available on Internet: http://pubs.usgs.gov/pp/p1625a/Chapters/SB.pdf.

Rogers, P. 2002. Using Forest Health Monitoring to Assess Aspen Forest Cover Change in the Southern Rockies Ecoregion. Ogden, Utah: USDA Forest Service, Rocky Mountain Research Station, p. 5.

Roggenbuck, J.W. and A.E. Watson. 1988. Wilderness Recreation Use: The Current Situation. Available on Internet: http://www.fs.fed.us/rm/pubs_other/rmrs_1989_watson_a001.pdf.

Rosentreter, R., M. Bowker, and J. Belnap. 2007. A Field Guide to Biological Soil Crusts of Western U.S. Drylands: Common Lichens and Bryophytes.

Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1991. Biological Consequences of Ecosystem Fragmentation: A Review. Conservation Biology 5:18-32.

Schaeffer, C.M. 2010. Personal communication with Claire M. Schaeffer, Program Analyst, Mineral Management Service, Denver, Colorado and Caleb Hiner, Bureau of Land Management. March 1.

Shepler, G. 2008. Personal communication between Glenda Shepler, Wyoming Field Office, National Agricultural Statistics Service, and J. Sidon, Science Applications International Corporation. March.

Shimkin, D.B. 1947. Wind River Shoshone Ethnography. University of California Press, Berkeley, California.

Shively, K.J., A.W. Alldredge, and G.E. Phillips. 2005. Elk Reproductive Response to Removal of Calving Season Disturbance by Humans. Journal of Wildlife Management 69:1073-1080.

Shoshone Conservation District. 2006. Shoshone Conservation District Long Range Plan 2006-2011. Shoshone Conservation District.

Shoshone River Watershed Plan Steering Committee. 2008. Draft Shoshone River Watersheds Plan.

South Big Horn Conservation District. 2006. South Big Horn County, Wyoming Watershed Plan 2006-2011. South Big Horn Conservation District.

South Big Horn Conservation District. 2007. South Big Horn Conservation District 2007-2012 Long Range Plan. South Big Horn Conservation District.

State of Wyoming. 2004. Statute 9-4-601: Distribution and Use; Funds, Accounts, Cities and Towns Benefited; Exception for Bonus Payments.

Stewart, K.M., R.T. Bowyer, J.G. Kie, N.J. Cimon, and B.K. Johnson. 2002. Temporospatial Distributions of Elk, Mule Deer, and Cattle: Resource Partitioning and Competitive Displacement. Journal of Mammalogy 83(1):229-244.

Stohlgren, T.J., I.D. Schell, and B.V. Huevel. 1999. How Grazing and Soil Quality Affect Native and Exotic Plant Diversity in Rocky Mountain Grasslands. Ecological Applications 9:45-64.

Taylor, D.M. 1986. Effects of Cattle Grazing on Passerine Birds Nesting in Riparian Habitat. Journal of Range Management 39(3):254-258.

Taylor, D.T., R.H. Coupal, T. Foulke, and J.G. Thompson. 2004. The Economic Importance of Livestock Grazing on BLM Land in Fremont County Wyoming. University of Wyoming Department of Agricultural and Applied Economics. October.

Temple, S.A. 1985. Ecological Principles of Wildlife Management. Pages 11-21. In: Management of Nongame Wildlife in the Midwest: A Developing Art. Edited by J.B. Hale, L.B. Best, and R.L. Clawson. Proceedings of a Symposium held at the 47th Midwest Fish and Wildlife Conference. Grand Rapids, Michigan. December 17.

Thomas, L.E. 1965. Sedimentation and Structural Development of the Bighorn Basin. American Association of Petroleum Geologists Bulletin 49:1867-1877.

Thompson III, F.R., J.R. Probst, and M.G. Raphael. 1993. Silvicultural Options for Neotropical Migratory Birds. In: Status and Management of Neotropical Migratory Birds. Edited by D.M. Finch and P.W. Stangel. USDA Forest Service General Technical Report RM-229. pp. 353-362.

Torre,I., M. Diaz, J. Martinez-Padilla, R. Bonal, J. Vinuela, and J.A. Fargallo. 2007. Cattle Grazing, Raptor Abundance and Small Mammal Communities in Mediterranean Grasslands. Basic and Applied Ecology 8(6):565-575.

USACE (U.S. Army Corps of Engineers) and BOR (Bureau of Reclamation). 2009. Reclamation Managing Water in the West: Bighorn Lake Sediment Management Study. Final Draft Report, September.

U.S. Census Bureau. 1990. 1990 Census of Population and Housing. U.S. Department of Commerce, U.S. Census Bureau. Washington, D.C.

U.S. Census Bureau. 2000. 2000 Census of Population and Housing. U.S. Department of Commerce, U.S. Census Bureau. Washington, D.C.

U.S. Census Bureau. 2009a. County Characteristics: Selected Age Groups and Sex. U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. Available on Internet: http://www.census.gov/popest/ counties/asrh/. Accessed June 2009.

U.S. Census Bureau. 2009b. Table 2: Annual Estimates of the Resident Population by Sex and Age for Wyoming: April 1, 2000 to July 1, 2008. U.S. Department of Commerce, U.S. Census Bureau. Washington, D.C. Available on Internet: http://www.census.gov/popest/states/asrh/. Accessed June 2009.

U.S. Census Bureau. 2009c. County Business Patterns (Big Horn, Hot Springs, Park, Washakie Counties). U.S. Department of Commerce, U.S. Census Bureau. Washington, D.C. Available on Internet: http://www.census.gov/econ/cbp/index.html. Accessed August 2009.

U.S. Census Bureau. 2009d. Table 1: 2008 Poverty and Median Income Estimates – Counties. U.S. Department of Commerce, U.S. Census Bureau, Small Area Estimates Branch. Released December 2009. Available on Internet: http://www.census.gov/did/www/saipe/county.html. Accessed June 2010.

U.S. Census Bureau. 2009e. Wyoming County Population by Race Alone and Hispanic Origin: 2000-2009. U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. Available on Internet: http://www.census.gov/popest/counties/asrh/.eadiv.state.wy.us/pop/CO_RO09.htm. Accessed June 2010.

U.S. Census Bureau. 2010a. Annual Estimates of the Population for Counties of Wyoming: April 1, 2000 to July 1, 2009. U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. March 23. Available on Internet: http://eadiv.state.wy.us/pop/CO-09EST.htm. Accessed June 2010.

U.S. Census Bureau. 2010b. Annual Estimates of the Resident Population by Sex and Five-Year Age Groups for the United States: April 1, 2000 to July 1, 2009. U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. Available on Internet: http://www.census.gov/popest/national/asrh/./NC-EST2009/NC-EST2009-01.xls. Accessed June 2010.

U.S. Census Bureau. 2010c. Annual Estimates of the Resident Population by Sex and Selected Age Groups for the United States: April 1, 2000 to July 1, 2009. U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. Available on Internet: http://www.census.gov/popest/national/asrh/./NC-EST2009/NC-EST2009-02.xls. Accessed June 2010.

U.S. Census Bureau. 2010d. Estimates of the Resident Population by Age and Sex for Wyoming: 2000 to 2009. U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. Available on Internet: http://eadiv.state.wy.us/pop/ST_AS09.htm. Accessed June 2010.

U.S. Census Bureau. 2010e. Annual Estimates of the Population by Sex and Age for Wyoming Counties: April 1, 2000 to July 1, 2009. U.S. Department of Commerce, U.S. Census Bureau. Available on Internet: http://eadiv.state.wy.us/pop/CO_AS09_GP.htm. Accessed June 2010.

U.S. Census Bureau. 2010f. Annual Estimates of the Resident Population by Sex, Race, and Hispanic Origin for the United States: April 1, 2000 to July 1,2009 (NC-EST2009-03). U.S. Department of Commerce, U.S. Census Bureau, Population Division. Washington, D.C. Available on Internet: http://www.census.gov/popest/statespopest/national/asrh/SC-EST2008-03NC-EST2009-srh.html. Accessed June 2010.

University of Wyoming. 1994. Gap Analysis Program Data.

USDA (U.S. Department of Agriculture). 1999. Census of Agriculture, 1997: Wyoming State and County Data. U.S. Department of Agriculture, National Agricultural Statistics Service. Vol. 1, Geographic Area Series, Part 50. Available on Internet: http://usda.mannlib.cornell.edu/reports/census/ac97awy.pdf. Accessed July 2009.

USDA. 2004. Census of Agriculture, 2002: Wyoming State and County Data. U.S. Department of Agriculture, National Agricultural Statistics Service. Vol. 1, Geographic Area Series, Part 50. Available on Internet: http://www.agcensus.usda.gov/Publications/2002/Vol._1,_Chapter_1_State_Level/Wyoming/WYVol.104. Accessed July 2009.

USDA. 2008. Major Land Resources Areas of MO-4. U.S. Department of Agriculture. Available on Internet: http://www.mt.nrcs.usda.gov/soils/mlra/mlramap.html.

USDA. 2009. Census of Agriculture, 2007: Wyoming State and County Data. National Agricultural Statistics Service. Vol. 1, Geographic Area Series, Part 50. Available on Internet: http://www.agcensus.usda.gov/Publications/2007/Full_Report/Vol._1,_Chapter_1_State_Level/Wyoming/wyv1.pdf. Accessed July 2009.

USDA and DOI. 2000. National Fire Plan. U.S. Department of Agriculture and U.S. Department of the Interior.

USFS (U.S. Forest Service). 1985. Final Environmental Impact Statement for the Shoshone National Forest Land and Resource Management Plan. Cody, Wyoming.

USFS. 2005a. Bighorn National Forest Revised Land and Resource Management Plan. November. U.S. Department of Agriculture, Forest Service.

USFS. 2005b. Influence of Precommercial Thinning on Snowshoe Hares. Research Paper PNW-RP-562. U.S. Department of Agriculture, Forest Service.

USFS. 2007a. Personal communication between J. Sorkin (BLM) and T. Svalberg (USFS) regarding air quality. U.S. Department of Agriculture, Forest Service.

USFS. 2007b. Bark Beetle Incident Implementation Plan 2007 to 2011: Narrative. U.S. Department of Agriculture, Forest Service. Available on Internet: http://www.fs.fed.us/r2/bark-beetle/BBIM_Implementation_Plan_Narrative.pdf. Accessed November 30, 2009.

USFS. 2009. Nez Perce National Historic Trail. U.S. Department of Agriculture, Forest Service. Available on Internet: http://www.fs.fed.us/npnht/.

USFS, BLM, BIA, USFWS, and NPS. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy.

USFWS (U.S. Fish and Wildlife Service). 2002. Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances. U.S. Fish and Wildlife Service. Utah Field Office, Salt Lake City, Utah.

USFWS. 2007. U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program Mountain-Prairie Region Strategic Plan, Wyoming. U.S. Fish and Wildlife Service.

USFWS. 2008. National Wetland Inventory Data. U.S. Fish and Wildlife Service.

USFWS. 2009. Gray Wolf Species Profile. U.S. Fish and Wildlife Service. Available on Internet: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A00D. Accessed July 27, 2009.

USFWS. 2010. Federal Register - 12-Month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered. March 4. U.S. Fish and Wildlife Service.

USGS (U.S. Geological Survey). 2007. Environmental Effects of Off-Highway Vehicles on Bureau of Land Management Lands: A Literature Synthesis, Annotated Bibliographies, Extensive Bibliographies, and Internet Resources. U.S. Geological Survey.

USGS. 2008a. Assessment of Undiscovered Oil and Gas Resources of the Bighorn Basin Province, Wyoming and Montana, 2008. Fact Sheet 2008-3050, 2 pp. U.S. Geological Survey. Available on Internet: http://pubs.usgs.gov/fs/2008/3050/. Accessed March 3, 2009.

USGS. 2008b. Assessment of Moderate- and High-Temperature Geothermal resources of the United States; Fact Sheet 2008-3082, 4 pp. U.S. Geological Survey.

USGS. 2008c. National Biological Infrastructure, Gap Analysis Program. Wyoming State Data. U.S. Geological Survey.

USGS. 2009. Madison Aquifer. U.S. Geological Survey. Available on Internet: http://water.usgs.gov/ogw/karst/aquifers/madison/index.

USGS. 2010. Climate Change in Mountain Ecosystems. U.S. Geological Survey. Available on Internet: www.nrmsc.usgs.gov/research/global.htm. Accessed July 27, 2010.

Vavra, M. 1992. Livestock and Big Game Forage Relationships. Rangelands 14(2):57-59.

Veil, John A., M.G. Puder, D. Elock, and R.J. Redweik, Jr. 2004. A White Paper Describing Produced Water from Production of Crude Oil, Natural Gas, and Coal Bed Methane. Prepared by Argonne National Laboratory for U.S. Department of Energy, National Energy Technology Laboratory.

WAFWA (Western Association of Fish and Wildlife Agencies). 2007. Wild Sheep Working Group Initial Subcommittee Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat. June 12. Available on Internet: http://www.mwvcrc.org/bighorn/wafwawild sheepreport.pdf.

WARM (Water and Atmospheric Resource Monitoring). 2009. Available on Internet: http://12.183.80.118/station.php.

Washakie County. 2004. Comprehensive Plan. Washakie County, Wyoming. Available on Internet: http://washakiecounty.net/cmpdrft.htm. Accessed August 2009.

Washakie County Conservation District. 2005. Long Range Program, Natural Resource Land Use Plan, Adopted 2001 - Amended 2005.

Washakie County Conservation District. 2006. Big Horn River Watershed Management Plan, Washakie County, Wyoming 2006-2011.

Washakie County Conservation District. 2009. History of the Washakie County Conservation District. Available on Internet: http://www.conservewy.com/history.htm.

WDA (Wyoming Department of Agriculture). 2008. Wyoming Department of Agriculture Strategic Plan.

WEPP (Water Erosion Prediction Project). 2008. Available on Internet: http://www.ars.usda.gov/Research/docs.htm?docid=10621.

Westerling, A.L, H.G. Hidalgo, D.R. Cayan, and T.W. Swetam. 2006. Warming and Earlier Spring Increase Western U.S. Wildfire Activity. Science 313(5789):940-943.

Western Regional Climate Center. 2009. Climate data available for the West. Available on Internet: http://www.wrcc.dri.edu.

WGFD (Wyoming Game and Fish Department). 2000. Sage-Grouse Annual Report and Summary Data of the Cody Region, 1956-1999. Wyoming Game and Fish Department, Cheyenne, Wyoming.

WGFD. 2001. Strategic Habitat Plan. Wyoming Game and Fish Department, Cheyenne, Wyoming. Available on Internet: http://gf.state.wy.us/habitat/StrategicPlan/index.asp.

WGFD. 2004. Annual Sage-Grouse Report, 2000 to 2004. Wyoming Game and Fish Department, Cheyenne, Wyoming.

WGFD. 2005a. A Comprehensive Wildlife Conservation Strategy for Wyoming. Species of Greatest Conservation Need List. Wyoming Game and Fish Department, Cheyenne, Wyoming. Available on Internet: http://gf.state.wy.us/wildlife/CompConvStrategy/.

WGFD. 2005b. Comprehensive Wildlife Conservation Strategy for Wyoming. Species of Concern. Wyoming Game and Fish Department, Cheyenne, Wyoming. Available on Internet: http://www.wildlifeactionplans.org/pdfs/action_plans/wy_action_plan.pdf. Accessed October 9, 2009.

WGFD. 2008. Aquatic Resources Database. Wyoming Game and Fish Department, Cheyenne, Wyoming.

WGFD. 2009. Recommendations for Development of Oil and Gas Resources within Crucial and Important Wildlife Habitats. Wyoming Game and Fish Department, Cheyenne, Wyoming.

WGFD. 2010. Wildlife Protection Recommendations for Wind Energy Development in Wyoming (Draft). March. 74 pp.

WGFD and BLM. 1990. Umbrella Memorandum of Understanding Between Wyoming Game and Fish Department and United States Department of the Interior Bureau of Land Management (Wyoming) for Management of Fish and Wildlife Resources on the Public Lands. March.

WGFD and BLM. 2007. Sage-Grouse Habitat Management Guidelines for Wyoming.

WHDP (Wyoming Housing Database Partnership). 2009a. A Profile of Wyoming - Demographics, Economics and Housing. Semiannual Report, Ending December 31, 2009. Sponsored by the Wyoming Community Development Authority. Prepared by Western Economic Services, LLC, Portland, Oregon.

WHDP. 2009b. The Wyoming Profile of Demographics, Economics and Housing. Semiannual Report, Ending June 30, 2008. Sponsored by the Wyoming Community Development Authority. Prepared by Western Economic Services, LLC, Portland, Oregon.

WOGCC (Wyoming Oil and Gas Conservation Commission). 2007. Wyoming Oil and Gas Conservation Commission website and database for existing oil and gas fields by county.

WOGCC. 2008. Well Status Report. Wyoming Oil and Gas Conservation Commission. Casper, Wyoming.

WOGCC. 2009. Wyoming Well Data and Statistics: Wyoming Oil and Gas Conservation Commission Online database. Available on Internet: http://wogcc.state.wy.us.

Woods, L.M. 1997. Wyoming's Big Horn Basin to 1901: A late Frontier. The Arthur H. Clark Foundation, Spokane, Washington.

Wyoming State Office of Travel and Tourism. 2007. Discover the Impact of Tourism in Wyoming – 2006 Impact Report. Wyoming Travel and Tourism. Available on Internet: http://www.wyomingbusiness.org/pdf/tourism/2006_Impact_Report.pdf.

Wyoming SBLC (State Board of Land Commissioners). 2009. Approval of Special Use Lease Application. Board Matter D-21, April 9.

Wyoming Department of Employment, Office of Mine Inspector. 2008. Annual Report of the State Inspector of Mines of Wyoming, Year Ending December 31, 2008. Available on Internet: http://doe.wyo.gov/ProductionDocuments/Mines/2008%20Annual%20Report%20PDF_Report.pdf. Accessed August 16, 2010.

Wyoming Department of Employment. 2010. Wyoming Benchmark Labor Force Estimates – Annual Averages, 2000-2009. April. Available on Internet: http://doe.state.wy.us/lmi/LAUS/0004aa.htm. Accessed June 2010.

Wyoming DEQ (Department of Environmental Quality). 2002. Wyoming Surface Water Quality Standards – Implementation Policies for Antidegradation, Mixing Zones, Turbidity, Use Attainability Analysis. Wyoming Department of Environmental Quality. Cheyenne, Wyoming.

Wyoming DEQ. 2004. Water Quality Rules and Regulations, Chapter 2 – Permits Regulations for Discharges to Wyoming Surface Waters. Wyoming Department of Environmental Quality. Cheyenne, Wyoming. Available on Internet: http://deq.state.wy.us/wqd/WQDrules/Chapter_02.pdf. Accessed August 27, 2009.

Wyoming DEQ. 2007. Water Quality Rules and Regulations Chapter 1, Wyoming Surface Water Classification List. Wyoming Department of Environmental Quality. Cheyenne, Wyoming. Available on Internet: http://deq.state.wy.us/wqd/watershed/surfacestandards/index.asp. Accessed August 4, 2009.

Wyoming DEQ. 2008. Wyoming's 2008 Integrated Water Quality Assessment Report (305(b) Report) and 2008 303(d) List of Waters Requiring TMDLs. Wyoming Department of Environmental Quality. Cheyenne, Wyoming.

Wyoming DEQ. 2009a. Wyoming Visibility Monitoring Network. Wyoming Department of Environmental Quality. Cheyenne, Wyoming. Available on Internet: http://www.wyvisnet.com/.

Wyoming DEQ. 2009b. Air Quality Division. Wyoming Department of Environmental Quality. Cheyenne, Wyoming. Available on Internet: http://deq.state.wy.us/aqd/.

Wyoming DEQ, Abandoned Mine Land Division. No Date. AML General Information. Wyoming Department of Environmental Quality. Cheyenne, Wyoming.

Wyoming DEQ, Abandoned Mine Land Division. 2008. Personal communication between Bureau of Land Management and Wyoming DEQ regarding the location of AML sites within the Bighorn Basin Planning Area.

Wyoming DEQ, Abandoned Mine Land Division. 2009a. AML Dangers. Wyoming Department of Environmental Quality. Cheyenne, Wyoming. Available on Internet: http://deq.state.wy.us/aml/Dangers.htm.

Wyoming DEQ, Abandoned Mine Land Division. 2009b. Personal communication between Marcia Murdock, Wyoming DEQ and Randall Coleman, ICF International.

Wyoming DOR (Department of Revenue). 1999. 1999 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2000. 2000 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2001. 2001 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2002. 2002 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2003. 2003 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2004. 2004 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2005. 2005 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2006. 2006 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2007. 2007 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2008. 2008 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed October 2009.

Wyoming DOR. 2009. 2009 Annual Report. Wyoming Department of Revenue. Cheyenne, Wyoming. Available on Internet: http://revenue.state.wy.us/PortalVBVS/DesktopDefault.aspx?tabindex=3&tabid=10. Accessed June 2009.

Wyoming DOR. 2010. 2009 Annual Report. Available on Internet: http://revenue.state.wy.us/PortalVBVS/uploads/Department%20of%20Revenue%20%2010.29.2009.pdf. Accessed June 2010.

Wyoming Economic Analysis Division. 2008. Population for Wyoming, Counties, Cities, and Towns: 2000 to 2030. Cheyenne, Wyoming: State of Wyoming, Department of Administration and Information, Economic Analysis Division.

Wyoming Economic Analysis Division. 2009a. Wyoming Sales, Use, and Lodging Tax Revenue Report. Cheyenne, Wyoming: State of Wyoming, Department of Administration and Information, Economic Analysis Division. October.

Wyoming Economic Analysis Division. 2009b. Annual Estimates of Housing Units for Counties in Wyoming: April 1, 2000 to July 1, 2008. Available on Internet: http://eadiv.state.wy.us/pop/cty08hu-est.htm. Accessed August 6, 2009.

Wyoming Economic Analysis Division. 2010. Wyoming Cost of Living for the Fourth Quarter 2009. Cheyenne, Wyoming: State of Wyoming, Department of Administration and Information, Economic Analysis Division. April 1. Available on Internet: http://eadiv.state.wy.us/wcli/NewsRelease-4Q09.pdf.

Wyoming Game and Fish Commission. 2008. Wyoming Gray Wolf Management Plan. November 18.

Wyoming Geographic Information Science Center. 1998. Wyoming Ground Water Vulnerability Assessment Handbook. Spatial Data and Visualization Report 98-01. Editors: J.D. Hamerlinck and C.S. Arneson. Available on Internet: www.sdvc.uwyo.edu/groundwater/report.html.

Wyoming Interagency Vegetation Committee. 2002. Wyoming Guidelines for Managing Sagebrush Communities with Emphasis on Fire Management. Wyoming Game and Fish Department and Wyoming BLM. Cheyenne, Wyoming, 53 pp.

Wyoming Office of the Governor. 2008. State of Wyoming Executive Department Executive Order EO-2008-2 Greater Sage-grouse Core Area of Protection.

Wyoming Sage-grouse Working Group. 2003. Wyoming Greater Sage-grouse Conservation Plan. 97 pp. Cheyenne, Wyoming.

Wyoming SHPO (State Historic Preservation Office). 2007. Wyoming's Comprehensive Statewide Historic Preservation Plan, 2007-2015.

Wyoming SHPO. 2009. Wyoming Cultural Resources Online (WYCRO). Database supplied by Wyoming State Historic Preservation Office. January.

Wyoming SPCR (Department of State Parks and Cultural Resources) – Trails Program. 2004. Wyoming Statewide Trails Plan 2004.

Wyoming SPHS (Department of State Parks and Historic Sites). 2003. Wyoming Statewide Comprehensive Outdoor Recreation Plan 2003-2008.

Wyoming State Auditor. 2010. Comprehensive Annual Financial Report - Basic Financial Statements for the Fiscal Year Ended June 30, 2009. Available on Internet: http://sao.state.wy.us/CAFR/cafr_report.htm. Accessed June 2010.

Wyoming State Division of Forestry. 2001. Wyoming Forest Health Report. Available on Internet: http://slfweb.state.wy.us/forestry/adobe/wyfhm.pdf.

Wyoming State Engineer's Office. 2006. Underground Water Database.

Wyoming State Engineer's Office. 2008. Public Accessible Database. Available on Internet: http://seo.state.wy.us/.

Wyoming State Geological Survey. 2008. Oil and Gas Group. Available on Internet: http://www.wsgs.uwyo.edu/WSGSgroups/OILGAS/Default.aspx.

Wyoming State Treasurer's Office. 2010. FY 2009 Annual Report.

Wyoming State-wide Bighorn/Domestic Sheep Interaction Working Group. 2004. Final Report and Recommendations. Available on Internet: http://gf.state.wy.us/wildlife/Sheep/index.asp.

Wyoming Water Development Commission. 2003. Wind/Bighorn River Basin Water Plan. Available on Internet: http://waterplan.state.wy.us/plan/bighorn/bighorn-plan.html.

Wyoming Weed and Pest Council. 2008a. Wyoming Weed and Pest Control Act Designated List. Available on Internet: http://www.wyoweed.org/statelist.html.

Wyoming Weed and Pest Council. 2008b. Wyoming Weed and Pest Control Act Declared List of Weeds and Pests. Available on Internet: http://www.wyoweed.org/Documents/WWFPage/2008DeclaredList.pdf.

Wyoming Wilderness Coalition. 2004. Wilderness at Risk: Citizens' Wilderness Proposal for Wyoming BLM Lands.

Yarmoloy, C., M. Bayer, and V. Geist. 1988. Behavior Responses and Reproduction of Mule Deer, *Odocoileus hemionus*, Does Following Experimental Harassment with an All-Terrain Vehicle. Canadian Field-Naturalist 102:425-429.

Young, J.A., B.M. Christensen, M.S. Schaad, M.E. Herdendorf, G.F. Vance, and L.C. Munn. 1999. A Geographic Information System to Identify Areas for Alternative Crops in Northwestern Wyoming. pp. 176-180. In: J. Janick (ed.), Perspectives on New Crops and New Uses. ASHS Press, Alexandria, Virginia.